FRY'S PURE CONCENTRATED COCOA.

# THE PRACTICAL TEACHER

PART I.
Published Tuesday, March 21st.

## CONTENTS
OF THE
## APRIL NUMBER

| | PAGE |
|---|---|
| EDUCATION IN PARLIAMENT | 487 |
| N.U.T. NOTES | 488 |
| LLANDUDNO AND NEIGHBOURHOOD. By James Hy. S. Stevens | 490 |
| THE COMING CONFERENCE OF THE N.U.T. AT LLANDUDNO: the President-Elect, Mr. Tom John | 496 |
| NOTES FROM THE NORTH | 500 |
| THE FEDERAL CAPITAL OF AUSTRALIA | 502 |
| THE HARMSWORTH ENCYCLOPÆDIA | 503 |
| NATURE NOTES FOR THE MONTH: SPRING MIGRATION | 505 |
| NOTES OF LESSONS ON HOW PLANTS FEED | 508 |
| OUR ILLUSTRATED GEOGRAPHICAL NOTE-BOOK | 509 |
| SOME BOOK NOTES | 512 |
| SUGGESTIONS IN CONNECTION WITH THE CORRELATED SCHEME OF WORK FOR AN INFANTS' SCHOOL | 513 |
| SCHOOL GARDENING FOR LITTLE CHILDREN. By Lucy R. Latter | 516 |
| FRENCH PRIZE COMPETITION | 521 |
| OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE. By A. T. Flux | 522 |
| OUR CERTIFICATE COURSE FOR 1905. By George Collar | 526 |
| CHEMISTRY. By C. A. West | 530 |
| PHYSIOGRAPHY | 532 |
| THEORETICAL MECHANICS. By Frank Castle | 534 |
| MATHEMATICS. By Frank Castle | 536 |
| OUR QUERY COLUMN | 538 |

·VOL· XXV
No 10

EDITORIAL, PUBLISHING AND ADVERTISING OFFICES OF "THE PRACTICAL TEACHER"
T. NELSON & SONS, 35 and 36 Paternoster Row, London, E.C.
EDINBURGH, DUBLIN, and NEW YORK

PRICE 6D.

# A GREAT EXPERIMENT

**Messrs. METHUEN have just begun the publication of the most interesting series which they have yet attempted. It is entitled "METHUEN'S STANDARD LIBRARY," and is an attempt to place the best books of all nations, and particularly of the Anglo-Saxon race, within the reach of every reader. All the great masters will be represented. Mr. Sidney Lee is the General Editor, and he contributes a note to each book. The price of an ordinary volume of this remarkable series is Sixpence net in paper. Thus you may obtain a novel of JANE AUSTEN, THE PILGRIM'S PROGRESS, Five Plays of SHAKESPEARE, PARADISE LOST, or THE MEDITATIONS OF MARCUS AURELIUS for Sixpence each. Very long books are issued in double volumes at One Shilling net each. Thus the great work of Edward Gibbon will be issued in Seven Double Volumes, and it is the finest edition in existence, containing all the extra notes by Professor Bury. Kindly ask your bookseller or newsagent to obtain for you the first Seven Volumes of "METHUEN'S STANDARD LIBRARY." You will have for 4s. the beginning of a magnificent Library. The books are beautifully printed on good paper. They are also issued in a handsome cloth binding at One Shilling net. Please ask or send for a Prospectus.**

*NOTE.—The Title of this Series has been changed from 'METHUEN'S UNIVERSAL LIBRARY" to "METHUEN'S STANDARD LIBRARY."*

**The Ancient World.** By E. M. WILMOT-BUXTON, Assistant Mistress, Brighton and Hove High School, Author of "Makers of Europe." With Maps and Illustrations. Crown 8vo, 3s. 6d.

"It is indeed a notable achievement, and the book would prove invaluable to any thoughtful boy or girl. We trust that this most commendable and truly educational enterprise will meet with the success it deserves."—*Schoolmaster.*

**The Story of the British Empire for Children.** By F. M. ANDERSON. With many full-page Illustrations. Crown 8vo, 2s.

H. M. INSPECTOR OF SCHOOLS writes: "I think it is well adapted in style and matter for use in Elementary Schools, and if teachers or managers consult me as to choice of books I should have no hesitation in recommending it."

**A Historical Geography of the British Empire.** By H. B. GEORGE, M.A. Crown 8vo, 3s. 6d.

*Included in the School World's List of Most Notable School-Books of 1904.*

"An admirably concise sketch. Mr. George's well-proportioned sketch is a welcome addition in this all-important subject. The structure, consolidation, and expansion of the British Islands is first treated, and followed by an interesting account of modern England with her marvellous growth of commerce."—*Journal of Education.*

**Easy Exercises in Arithmetic.** Containing 5000 Original Examples. By W. S. BEARD. Fcap. 8vo, cloth. With Answers, 1s. 3d.; without answers, 1s.

**Now in use at upwards of One Hundred large Schools in England and Wales.**

***Please Write for a Specimen Copy.***

METHUEN & CO., 36 ESSEX STREET, LONDON, W.C.

# DELEGATES

to the **Easter Conference** at Llandudno, desirous of examining the latest Educational Publications

# SHOULD NOT

forget to make a point of visiting the Publishers' Exhibition, and particularly should not

# FAIL TO VISIT

the Exhibition of School Books and appliances, etc., as displayed by

# T. NELSON & SONS

All the latest up-to-date Publications will be shown, and Teachers and others are specially invited to view their unique

# EXHIBIT

**AT THE PIER PAVILION. No. 21.**

## THOMAS NELSON & SONS

**LONDON, EDINBURGH, DUBLIN, AND NEW YORK**

THE

# PRACTICAL TEACHER

A MONTHLY MAGAZINE AND REVIEW

FOR THE SCHOOL-ROOM AND THE STUDY

**Vol. XXV. No. 10. APRIL, 1905. Price 6d.**

**NOTICES TO CORRESPONDENTS AND SUBSCRIBERS.**

"The Practical Teacher" may be ordered of any Newsagent or Bookseller, or at any Bookstall, in the United Kingdom or in the Colonies. Supplies are sent monthly to the chief towns in Australasia, South Africa, and India.

London Office: 35 and 36 Paternoster Row.
Edinburgh Office: Parkside Works.
Dublin Office: 17 Talbot Street.
New York Office: 37 East 18th Street.
Paris: W. H. Smith and Son, 248 Rue de Rivoli.

Subscribers may obtain "The Practical Teacher," post free, from the Publishers at the following terms:—

United Kingdom, Continent, Colonies, and United States } 12 Months, 8/- 6 Months, 4/-

All literary communications should be addressed to the Editor, Office of "The Practical Teacher," 35 and 36 Paternoster Row, London, E.C.

Remittances, Cheques, Post-Office Orders, etc., should be made payable to Thomas Nelson and Sons. Advertisement rates on application.

## EDUCATION IN PARLIAMENT.

### OPENING OF THE SESSION.

EVERYBODY went to Westminster dubiously. It seemed quite likely that there would be no session to speak of—that members would meet only to hail and separate, like "ships that pass in the night." But in spite of the most adverse winds that ever Government experienced, the ships were got into fighting line, and the King's orders were duly read to the fleet. This particular Parliament may be moribund, but never was the opening ceremony more solemnly and gorgeously performed. The "sea-king's daughter from over the sea" never looked more beautiful, august, and sweet; the Gilded Chamber housed "a dream of fair women"; the monarch and his consort on the throne realised in mien, attire, and port all that the most loyal devotee of the monarchic principle could wish. The Lord Chancellor with his accustomed grace and stateliness handed "His Majesty's speech in His Majesty's own words" to the King, and, in far better elocution than nine out of ten of the speakers in that chamber, the King announced that "the partially considered provisions for amending the laws relating to education in Scotland" were again to be brought before Parliament—the one and only reference to education in the Speech.

Mr. Graham Murray, who had the Bill in charge last year, will know it no more, except upon the judicial bench. Gone from the House of Commons, he is Lord Dunedin now; and now, perhaps, as a lord he will think it *infra dig.* to ride a bicycle; for upon such a humble and plebeian instrument of transit he used to reach the House of Commons, accompanied part of the way by a bulldog and a pipe. He has gone, his constituency knows him no more, and in returning Mr. Lamont in his place the constituency, it is said, "have given the Government the Bute"! Woe worth the chances of the Scottish Education Bill this session, with the gallant Graham Murray gone. A yarn has reached the House (apropos of *infra dig.*), that a certain Scottish bailie, who had suffered from lack of schooling in his youth, when discussing the Bill of last year, announced that he "considered its proposals *intro frig.*" What he said considering the new Bill is yet to be made known. The impression prevails that the prospects of a new Act are clouded. For the question in every mouth is, "Can the Government live?"

Anyhow, the Opposition failed to kill it during the debates upon the Humble Address to the King. Mr. Ellis Griffith and Mr. Dillon levelled educational ordnance at the Government in the shape of amendments on educational matters; so also, greatly daring his party, did Mr. Gray. But all three presented their guns in vain; the powder was dry, but the opportunities were inauspicious. Mr. Ellis Griffith never found his chance to move "That we humbly regret that Your Majesty's Speech contains no proposals to amend the provisions of the Education Act of 1902, so as to remove the difficulties of administering the Act in Wales." Mr. Dillon, too, though he has returned to the House rejuvenated, got no chance to raise the burning question of a Roman Catholic State University for Ireland. And Mr. Gray's amendment, "That we humbly desire to represent to Your Majesty that the question of local taxation, particularly the distribution of the charges for the provision of public education and the relief of the poor, requires the serious attention of this House," was ruthlessly crowded out and then decapitated by the closure. It is thus that education gets the go-by this year.

Sir John Gorst and Dr. Macnamara got very angry with the Government early in the proceedings, because nothing definite is promised by Ministers in the way of legislation founded upon the Physical Deterioration Committee Report. One thing the Government seem to agree on firmly, and that is, to avoid empowering Local Authorities to provide scholars with meals at the cost of the rates. But, yielding a little to subsequent inquiries from Sir John and the member for Camber-

well, Ministers intimated that other recommendations by the said Committee were "receiving the consideration of their Departments." That is, however, a phrase which usually means nothing practical at all. A report is current as to the exact language used by a Government Whip who was pressed to recommend the Government to take up education again this year; but the language cannot be reported, being neither Parliamentary nor Pickwickian.

One of the absurdities, and yet, perhaps, one of the safeguards of parliamentary procedure, is the rule which prevents the unfinished Bills of one session being brought forward the next session at the stage where the necessities of fresh air and shooting caused them to be abandoned. Thus the Scottish Education Bill of last year has had to begin its career quite anew, to run the gauntlet of First Reading, Second Reading, and Reference to Committee, just as though such a Bill was a dangerous and offensive novelty never dreamed of before. Nothing, however, in the way of real novelty is likely to be brought forward in the Education way this session. Very firmly Ministers have refused to father an Anti-Cigarette and Juvenile Smoker Bill; it is said that several Ministers themselves consume cigarettes, and, having regard to the tender years and inexperience of some of the junior Ministers lately recruited, perhaps the Bill in question was a little too much to expect.

The Bishop of Hereford might introduce an Anti-Cigarette Bill into the House of Lords, if he wished. A Peer can introduce anything into the House of Lords any day. He has merely to put down notice that he means to move something or talk about something, and the House of Lords will meet to listen to him—even upon education. The Bishop of Hereford, however, is credited with the intention to introduce an Evening Continuation Schools Bill. As former head-master of Rugby, Dr. Percival is naturally more interested in education than most of the other Peers, and he considers that there is a great waste of time and opportunity involved in children leaving the day-school early and not going to evening schools at all. This Bill is said to propose, that unless a certain standard of attendance and attainments is reached by a child at day-school, it must be reached by him at an evening school afterwards; but this is not likely to get carried into law this year.

Meantime, the fate of Wales is hanging in the balance. Sir William Anson goes about the House of Commons darkly, hiding behind a pacific and even a mild and meek exterior the most portentous of resolves to see that Wales keeps the law. Of course, Wales ought to keep the law. "Be just before you are generous" is a proverb which Sir William, that eminent legist, would translate into "Carry out the Act before you go in for Revivals." But it does not appear that either the Revival or the dignified attitude of Sir William has softened the hard hearts of the members for Wales. The County Councillors of Wales, who refuse to carry out the law of 1902, are aided, abetted, and backed by the law-makers for Wales. This is sad but true, disgraceful but veritable. The national spirit is roused, and strains of the "Men of Harlech" come wafted on the wind. Like Ajax, Sir William Anson seizes the Default Act of 1904, and waits his moment to launch it at Mr. Lloyd-George. But he keeps a wary eye over his shoulder, for he is at any moment liable to be attacked in the rear.

Not by the Welsh: the Welsh adopt a frontal attack only. The people who are making danger for Sir William Anson's meek little back are the Church Schools Emergency League. The League are very angry with Sir William Anson, and threaten his seat. He is unfit to represent the University of Oxford and the parish clergy who elected him, because he refuses to allow children while attending church to be marked as attending school. Sir John Gorst leads on the Church Schools Emergency League to the fray. It is not to be supposed that Sir John cares very much about school children going to church on a week-day, but Sir John represents a constituency of county parsons himself. Moreover, Sir John had to give up his post in the Ministry to Sir William, so Sir John with some gusto joins himself with that eminent ecclesiastical lawyer and layman Mr. Cripps to speak for the Church Schools Emergency League.

So that Education is vindicated this session after all. If it is not the subject of many Bills and great Bills and epoch-making Bills, it affords the Ministerial post of chief danger. There are people who suppose that the Fiscal question is the question of the hour, and that the President of the Board of Trade is therefore the Minister most critically situated. Not a bit of it—the Minister who stands "on the burning deck," so to speak, between two fires, is Sir William Anson. And alone he does it, for his chief, the Marquis of Londonderry, sits in the Olympus of the Peers—serene.

# BY MANY HANDS.

*"Quot homines, tot sententiæ."*

## N.U.T. NOTES.

EASTER is unusually late this year, and for the first time since I commenced Conference going, its sessions will be held during the last week in April.

***Ready for Llandudno.***

The proximity to May will, in all probability, cause an abnormally large number of representatives and friends to journey to the Queen of North Wales, where, if the weather be at all favourable, they should have a delightful time. A dozen years ago, the practice was for only delegates to attend the Conference. To-day, there is, in addition, a host of relatives and friends who avail themselves of the countless attractions annually furnished by the local Committees. In the early nineties members rarely arrived at the Conference town before Easter Monday, the opening day. Nowadays quite a fair sprinkling of "early birds" set out on the day before Good Friday, whilst, before the Easter Sunday promenade, practically every one has taken up his quarters for the week. The usual railway concessions have been secured from the various companies, and return tickets at a single fare and a quarter for the double journey will be issued to members and others attending the Conference. This year the tickets will be issued on and after Wednesday, April 19th, and will be available for return on any day not later than Monday, May 1st, so that members may, if they please, have fully twelve days at the seaside.

An Inaugural Reception of the Members of Conference by the Local Conference Committee will take place on Thursday, April 20th, in the Reception Room at the Llandudno Town Hall, from 8 to 10 P.M., and will doubtless be largely attended. The official proceedings are timed to begin on Easter Monday at "11 A.M. punctually," at which hour the Chairman of the Llandudno Urban Council and other representative men of the town will attend and welcome the Conference. According to custom, they will be thanked by the retiring President and the immediate Ex-President, who may safely be relied on to refer to any "little points" which previous speakers have critically introduced. The installation of the first Welsh President on his native soil will be accompanied by a display of enthusiasm calculated to unnerve even the strongest. Conference is invariably kind to its Presidents, but the circumstances this year are so unique that Mr. Tom John will, in my opinion, break all previous records, so far as outward evidences of cordiality and goodwill are concerned. Mr. George Sharples will likewise receive an ovation on laying down the high office, whose dignity and importance he has done so much to enhance. A portentous list of "Deputations" will delay the luncheon hour, unless the tactful General Secretary is exceptionally fortunate in the reception of his friendly suggestions for that brevity which is the very "soul of wit."

THE second Public Session is mainly taken up by the President's address. Previous to 1902, this address was read at the end of a session which occasionally stretched its weary length to four or five hours, or even more. Representatives became every year more and more impatient at the Presidential utterance; and when, in his great desire to be comprehensive, my predecessor in the chair was responsible for an oration lasting an hour and forty minutes, one felt that the climax of absurdity was reached. The Executive resolved to try the experiment of two sessions on Easter Monday, in place of one, and to devote the afternoon to the chairman's educational pronouncement. It fell to my lot to open the ball under the new conditions, and I was a little anxious about the result. The sight of the Victoria Rooms, Bristol, crowded to their utmost capacity on a balmy spring day, convinced me, in a moment, of the wisdom of the innovation, and both Mr. Coward and Mr. Sharples have likewise been heard by enormous and attentive audiences. We may expect from Mr. Tom John an address worthy of the occasion, and he will doubtless have something to say on the Welsh educational crisis, to which he has devoted immense attention during the year. The subjects chosen by a ballot of the local associations for discussion during the third Public Session are Superannuation of Teachers, Examination of Scholars, the Feeding of Hungry Children, and Size of Schools and Classes. With the exception of the Feeding of Hungry Children, these are "hardy annuals," all-important in their way, and of absorbing interest to the teachers themselves, yet, in my judgment, not calculated to command a great amount of notice from the general press. I anticipate a big debate on the Superannuation question. A motion sent up by the West Ham Association suggests the revision of the Elementary Teachers' Superannuation Act, so as (1) to provide for an optional age for retirement; (2) to provide that a proportionate amount should be returned to the nominee or next-of-kin of a contributor when no benefit has been obtained by such contributor. These are far-reaching changes, the effect of which must be carefully considered, from every point of view. At the last Public Session, Salaries of Teachers, National System of Education, Staffing of Schools, and Discipline of Schools provide the bill of fare, and only the second of these topics is likely to be discussed outside the Conference Hall. The result of this year's voting makes me more than ever convinced that the arrangement of the business of the Public Sessions ought to be entirely in the hands of the Executive. Votes of thanks to the local officials and to all who have in any way assisted to make the Conference a success will be moved from the chair at 12 noon on Wednesday, half-an-hour before the time fixed for the closing of the Session.

**The Public Sessions.**

FROM 2 to 5 P.M. on Easter Tuesday, and during the same hours on the following day, the representatives will meet in "Private Session." At these meetings, only the reporters of the educational press are requested to attend, as the business refers solely to the internal work of the Union, and is of no public interest. The general public are not admitted to these sessions, although members of the Union, other than representatives, are allowed to sit in the gallery, on production of their certificate of membership for the current year. Beginning, if my memory serve me correctly, with the second Cheltenham Conference, these "Private Sessions" have, for a number of years, been characterised by a series of attacks on the personal honour of members of the Executive, sufficiently vile to make any man or woman possessing the normal amount of self-respect hesitate about retaining a seat in the Union's Parliament. Last year, as the result of a straight fight between the floor and the platform, a vote so decisive was given that I am in great hopes that something really useful will be the outcome of the six hours' palaver at Llandudno. Hitherto the financial statements have occupied an inordinate amount of time, and for this, the reports of the Examiners of Accounts are largely responsible. Half-an-hour (or less) should be sufficient to dispose of the whole question. My view of finances and balance sheets is simply this: A man either understands such things, or he doesn't. Personally, *I don't*, and it is a work of supererogation for me and those constituted similarly to attempt to acquire the art. When the necessary routine business has been cleared off, Conference will begin to debate over again the method of electing the Executive. The first motion on this subject—"That in all future elections to the Executive, the President, Vice-President, and Ex-Presidents shall be considered as members of the Executive for their respective areas, and that the number to be elected in those areas be reduced proportionately"—is one that I hope will be carried. The motion from West Bromwich and Wednesbury, "That in the opinion of this Conference, the Editor of *The Schoolmaster* be, *ex officio*, a member of the Executive," will receive scant consideration, in view of the strained relations between the Union and the Directors of the Educational Newspaper Company. After we have disposed of the election of the Executive, the "Arrangement of Conference Agenda, and Order of Business of Conference" comes under review, and the representatives will be invited to pass a solemn vote of censure

**The Private Sessions.**

on the proceedings of such of their predecessors as voted for, and carried, the suspension of the "standing orders" in bygone Conferences. What a sight 'twill be, to be sure! "Confidential Reports and Log-Book Entries," "Organ of the Union," "Information for Members of the Union," and "Code of Honour" follow in due order, and I am sanguine enough to think that, at last, the question of professional etiquette may be considered by the Conference.

* * *

***The Executive's Report.***

THE thirty-fifth Annual Report of the Executive to Conference strikes at the outset a congratulatory note: "The representations made on behalf of the Union are received by the Board of Education and the Local Education Authorities with a cordiality that does not diminish," and much more in the same strain. Then comes a solemn warning regarding the Union's finances, and members are asked to note that "the necessary expenditure of the Union increases with the growth of the operations of the Union; and the paying out of moneys from the funds of the Union to the funds of branches of it during the year, while the individual subscription to the Union remains unchanged in amount, cannot but before long produce a financial situation in which either the individual subscription will have to be increased, or the subsidies to Associations will have to be stopped." Next, the operations of the various standing committees are reviewed in considerable detail; and the place of honour is deservedly accorded to the Education Committee, which, under the chairmanship of Mr. Pickles and the secretaryship of Mr. Gray, M.P., annually gets through an enormous amount of work. An interesting table gives the results of the steps taken to secure the admission of practical teachers to the Councils of the various Local Education Committees, and this table I venture to reproduce:—

| | |
|---|---|
| (*a*) Number of teachers co-opted on the recommendation of the certificated teachers of the district | 124 |
| (*b*) Co-opted as teachers' representatives, without nomination | 51 |
| (*c*) Certificated teachers co-opted in addition to the above as persons of experience in education, or as representatives of other interests | 140 |
| (*d*) Other members of Education Committees (Councillors) holding the certificate of the Board of Education | 53 |
| (*e*) Officials similarly qualified | 32 |
| | 400 |

Salaries, Combination of Local Authorities, Non-Collegiate Teachers, Infants' Mistresses, &c., School Attendance, Large Schools, Illness, Staff Regulations, Discipline in Schools, Re-employment of Teachers, Joint Appointments, Diocesan Examination, Promotion of Children by means of Scholarships from Elementary Schools to Schools of a Higher Type, Pupil Teacher Centres, Registration of Teachers, Students' Declaration, and Secondary Schools, are some of the subjects dealt with by this important Committee, which easily holds the record for lengthy sessions at Bolton House. Many features of interest are comprised in the doings of the remaining standing committees, but I have only space to quote (from the Organisation Committee's Report) that there are now 54 County Associations, 479 Local Associations, and 54,002 members in the Union. The increase in membership during the year is 3352. The whole Report concludes with an expression of heartfelt gratitude to the local officers and members of councils or committees, without whose cordial assistance and co-operation the Union's work could not possibly prosper.

* * *

***The "B. and O." and the "T. P. S."***

THE close connection between the Benevolent and Orphan Fund, and the Teachers' Provident Society, and the Union is clearly evinced by the inclusion of lengthy paragraphs relating to their work in the Report of the Executive to Conference. I remember well the time when there seemed to be something like jealousy on the part of the elected members of the B. and O. Council towards the members nominated by the Executive; but this feeling is now entirely extinct, and perhaps no man has done more to create an *entente cordiale* between the two sections than Mr. T. G. West, the present Chairman of the Council. With the liveliest satisfaction, one notes that within the past five years the income of the Fund from subscriptions has been more than doubled, having advanced from £8140, 13s. 9d. in 1899 to £18,520, 1s. 11d. for 1904. This increased income has been wisely expended, and has been, moreover, necessary, in view of the very large number of serious cases of consumption and nervous breakdown,—cases requiring treatment that is both expensive and prolonged. Last year *only four* of the Local Associations in the Union failed to send up a contribution to the Fund, as against *sixty-nine*, only three years ago. This is gratifying progress indeed! The Benevolent and Orphan Fund enables us to do a little to assist our distressed brothers and sisters; the Teachers' Provident Society is a magnificent agency for helping *ourselves* in the hour of need. Both institutions are eminently necessary, being supplementary and complementary of each other. The work of the T. P. S. has, during the past year, shown exceptional progress and activity, no less than 2057 new members being enrolled. Even now, however, the membership of the Society stands only at 11,872; and I often wonder at the short-sightedness of the remaining 42,130 teachers in not allying themselves with what I have frequently described as "the best thing in the Union." Many new Local Agencies were formed in 1904; and it is not without excellent reasons that the Executive heartily recommend all teachers who have not yet joined to take advantage of the benefits which are offered by the Society at such exceptionally low rates.

A. C.

## LLANDUDNO AND NEIGHBOURHOOD.

BY JAMES HY. S. STEVENS,

*Hon. Sec. to Llandudno General Conference Committee and Conference Council.*

FOR the first time in the history of North Wales the N.U.T. intends to honour this part of the Principality by holding its Annual Conference, next Easter, at Llandudno. The number of votes polled in favour of the queen of Welsh watering-places, at the Portsmouth Conference last year, is sufficient proof of the popularity of this ideal holiday resort, and teachers were not slow in showing their keen desire of visiting it at their earliest opportunity in 1905.

For the purposes of Conference, no place could have been chosen offering so many facilities as Llandudno

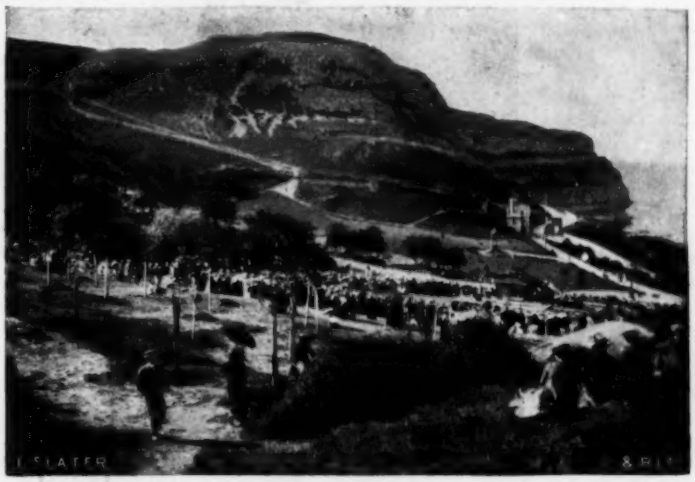
possesses; and teachers, who intend to visit it at Easter, cannot but conclude that better accommodation for the various functions that take place during the week could not have been found at any other place; and this, together with the charms and beauties that surround Llandudno, must leave an impression upon them never to be forgotten.

THE PARADE.

No one who visits Llandudno now, can imagine that a little over fifty years ago it was a mere fishing village, containing a few miserable houses, inhabited by fishermen and their families. At the present day, it consists of broad streets with shops of every description, and is large enough to accommodate nearly 30,000 visitors in addition to its ordinary population of 10,000. For the benefit of those who are not acquainted with the Welsh language, it is necessary to state here that the word "Llandudno" is compounded of the two words "Llan" and "Tudno," "Llan" being the prefix placed before the name of a patron saint—thus, Llan-Tudno is Saint Tudno, from which the town derives its name. Little or nothing is known of Saint Tudno, but it is supposed that he lived about the sixth century.

The district around Llandudno is very rich in its historical associations, even as far back as the Roman times. It is thought by some, that on a spot close to the town, now known as "Maes Du," the Britons were at one time stationed, and suffered defeat at the hands of the Romans, after which the latter encamped in a part of the town now known as Madoc Street. One could dwell at considerable length on many similar historical legends, but it must suffice to pass over the periods of long ago, and commence with the growth of Llandudno from a fishing village to its present state.

When it was discovered that Llandudno possessed such advantages as to make it an ideal seaside re-



HAPPY VALLEY.

sort, steps were taken to bring about its development. Plans were made for the laying out of the town, and building regulations drawn up. Land was

sold by auction to builders and speculators in 1849, and from that period the town has gradually increased, until it is one of the finest on the North Wales coast. As a health resort it is unrivalled. The late Dr. James Nicol, who resided at Llandudno for a considerable period, issued a table showing the average temperature of the town during the winter months for twenty years, and from January to March the temperature averaged from 41·4° to 43·4°, and from October to December 51·4° to 42·5° F. Compare this with statistics of other places in the United Kingdom, and it will be noticed that Llandudno stands very high from this point of view. This is no doubt due to a great extent to the influence of the Gulf Stream, whose waters mix with those of the Irish Sea which wash the shores of the North Wales coast.

Llandudno also enjoys a very large amount of sunshine, and is much sheltered by the Great Orme's Head, which stands out in bold relief on the west side of the bay. No wonder, then, that North Wales is proud of its "queen," and it needs no stretch of the imagination to apply to it the name of the "Cambrian Naples."

During the last twenty years Llandudno has made rapid strides in more senses than one. Everything that could be done for the comfort of those who annually spend their holidays there has been carried out regardless of cost. The drainage works alone have been constructed at a cost of over £136,000, and no town in the kingdom can claim to have a more efficient and up-to-date system than is found at this fashionable resort. The same can also be said of the water supply, which is obtained from two very large lakes—Llyn Dulyn and Melyn Llyn. The tourist who has time to spare should pay a visit to these, especially Llyn Dulyn, which is amongst the mountains, sixteen miles from Llandudno, and 1700 feet above the sea-level.

Undoubtedly, at Easter, there will be a large number of teachers who have not been in the locality before, and to whom the first visit will prove exceedingly interesting. They cannot but admire the magnificent Promenade, which stretches for two miles by the side of the bay, and which is ninety feet wide. A walk along the "front," as it is often described, is in itself exhilarating, and a sufficient tonic to sharpen the dullest appetite. The whole of the Promenade is asphalted, and it is one of the sights of the summer season to see the crowds strolling about, or walking on the sands of the seashore. Should the pedestrian feel tired he finds ample seating accommodation provided for taking a quiet rest, a large number of seats, capable of holding several hundreds, having been placed along the promenade facing the sea. There are also several very handsome shelters which have been placed there in recent years, which will protect him from wind, no matter from which point of the compass it may be blowing. The Promenade is lighted at night by a large number of arc lamps, as are also the principal streets of the town. Adjoining the Promenade is a very wide thoroughfare known as the "Parade," which has an ideal surface, much appreciated by those who are fond of cycling. The bay itself is in the form of a crescent, and the buildings, consisting chiefly of hotels and boarding-establishments, which face it and the Promenade, are amongst the largest in the town.

COUNCILLOR J. O. THOMAS, J.P.
Chairman Llandudno Urban District Council,
Chairman Conversazione Committee.

Llandudno is the proud possessor of a very fine pier over 800 yards in length, which stretches out into the sea in a north-easterly direction. Inside the en-

trance a magnificent pavilion has been constructed, just under the Great Orme's Head, capable of seating 4000 people. When it was decided to invite Conference to the town the Pier Company, at great inconvenience to itself, placed the whole of this building at the disposal of the teachers for Easter week, evenings excepted. It is in this spacious hall that Conference will hold its sessions, and delegates will have no difficulty in discovering its whereabouts when once they arrive on the Promenade.

Underneath the Pavilion is another large hall in which will be held the Publishers' Exhibition, which is expected to be one of the finest on record. All available space has been taken, and allotted to the various publishers applying for the same, and no one should go to Conference at Easter without giving the exhibition an early visit.

Every evening (Wednesday excepted) concerts will be held in the Pavilion by the Pier Company's orchestra, and also at the Pier Head every morning, weather permitting. A stroll on the pier should not be missed, and, circumstances permitting, the arrival of steamers at the Pier Head about 1 P.M. with their crowd of passengers from Liverpool and other places, is a sight which should be witnessed.

Another new and very fine building is the Town Hall, situated in Lloyd Street and only a short distance from the pier. This building has also been placed at the disposal of Conference by the Urban District Council, and delegates will here find the hand of welcome awaiting them, and all information possible ready to be given, the large hall of the building being used as the Conference Reception Room.

The various other functions which are always a feature of Conference will be held at the Hippodrome, a very fine hall on the "Front," facing the centre of the bay. This building is distinguishable from any part of the Promenade, and is not a very great distance from the pier.

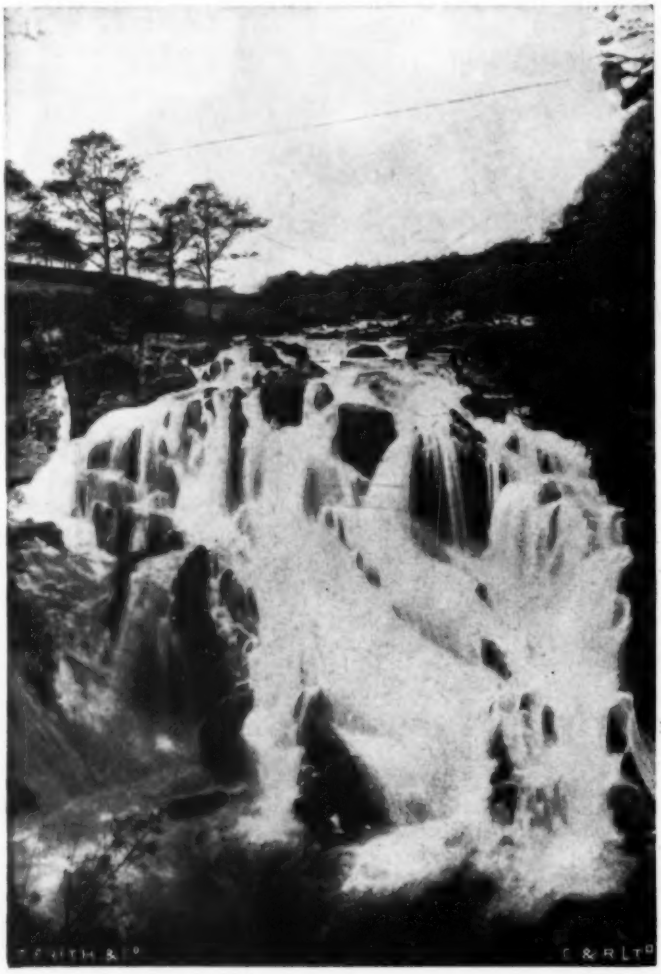
In educational matters Llandudno is to the fore. Excellent schools, provided and non-provided, some of the former being of recent construction, are successfully performing their daily tasks, "teaching the young ideas how to shoot." Scholarships are offered to those attending the Elementary Schools, for entrance to the County School, which is at present housed in temporary premises, under the mastership of J. M. Archer Thomson, Esq., M.A. There are also several private schools in the town and neighbourhood, which are attended by children from many parts of the United Kingdom.

GLODDAETH.

Mention has been made of the Great Orme, but teachers must see it and explore it to get any real idea of its majestic and imposing appearance. It is two miles across from east to west, and over six miles in circumference. To the climber it offers delightful exercise by walking to the top, while to those who prefer a quicker and much easier mode of travel the ascent may be made by the Great Orme Tramroad. The Orme itself is full of interest, containing the reputed site of a city—Pennydinas, Tudno's Cradle, remains of Gogarth Abbey, and the disused copper mines, which were in use from pre-Roman days to about fifty years ago. Some of the most delightful views can be obtained from the summit, and in the distance may be seen the Snowdonian Mountains, and very often the Isle of Man if the day be clear. Saint Tudno's Church, with its pretty churchyard, is also on the Orme. It is so old that even the date of its foundation is not known.

No visit to Llandudno would be complete without a journey round the Orme's Head *via* the Marine Drive. This fine and excellent roadway was completed in 1879

at a cost of £14,000, and is four miles in length. The visitor finds himself climbing higher and higher along a zig-zag road until the Lighthouse is reached, after which a gradual descent is made. There is an entrance at each end of the drive, at one of which the pedestrian must pay his toll of a penny before he starts on his journey round. The ticket which he receives must be given up upon leaving the drive at the other end, when he is soon back again in the town. The journey round



Swallow Falls.

the Drive can also be made by brake at a charge of 1s. each person, and many thousands avail themselves of this opportunity every year.

Any description of the Great Orme would be incomplete without reference to the Happy Valley, which is on the eastern slope of the Promontory and only one minute's walk from the Pier Pavilion. The valley was presented to the town by Lord Mostyn, and it contains a handsome drinking fountain presented by Lady Augusta Mostyn as a Queen's Jubilee gift.

Here in summer may be seen thousands of people enjoying, with the greatest delight, the *al fresco* entertainment provided by the Happy Valley Minstrels. It is one of the most delightful spots imaginable to spend a lazy afternoon, a tonic which the writer can recommend for a weary brain or tired body.

Opposite to the Great Orme, at the other end of the bay, is situated the Little Orme's Head. A ramble over this promontory will more than repay one for the walk to it from the town, it being about 2½ miles' distance from the Pier Gates. It abounds with natural cavities, one of them being known as the "Devil's Cave." The view from the top is very beautiful, Colwyn Bay, Rhyl, and the Vale of Clwyd being plainly seen in the distance.

As would be expected, Llandudno is naturally noted for its sandy beach, which affords great amusement to the youngsters who love to dabble in the sand, whilst their elders may either sit down in cosy, comfortable chairs, and watch them enjoying their fun, or if they prefer, take a dip in the briny. Fishing may also be indulged in by those who are fond of the sport, many excellent catches being sometimes made.

The local authority is the "Urban District Council," with J. O. Thomas, Esq., J.P., as its chairman. Mr. Thomas having taken a keen interest in the forthcoming visit of Conference to Llandudno, it was unanimously decided to ask him to continue in office as chairman for another twelve months, and he has graciously acceded to the request. He is also the chairman of the Conversazione Sub-committee, the Conversazione being a function which will be held on Easter Monday evening, at the Hippodrome, in place of the usual Conference Dinner.

The golf links at Llandudno, over which there is an 18-hole course, are the finest in the neighbourhood, and cannot fail to delight the golfer who wishes to pursue his hobby while in the town. The secretary is Mr. T. D. Cummins, St. George's Hotel, Llandudno, who will be pleased to give any information required.

About 1¼ mile from Llandudno is situated Gloddaeth Park and Woods, with a very fine old mansion dating from the Elizabethan period, and now occupied by the Lady Augusta Mostyn, the mother of the present Baron Mostyn. The house contains innumerable treasures, and visitors are permitted to go over it certain days on payment of the small sum of 1s., all money received being given to the income of the Sarah Nicol Cottage Hospital. There are numerous walks through the woods open to the public, and delegates will miss one of the prettiest spots around Llandudno if they do not visit these woods during their stay in the town.

Close to Gloddaeth Park is the Church of Eglwys Rhôs, the burial-place of the Mostyns. It is said that at the time of the "Yellow Pestilence," known as "Vad Velen," which raged throughout Europe, that Prince Maelgwyn Gwynedd took shelter here in order to avoid it, and died during his stay.

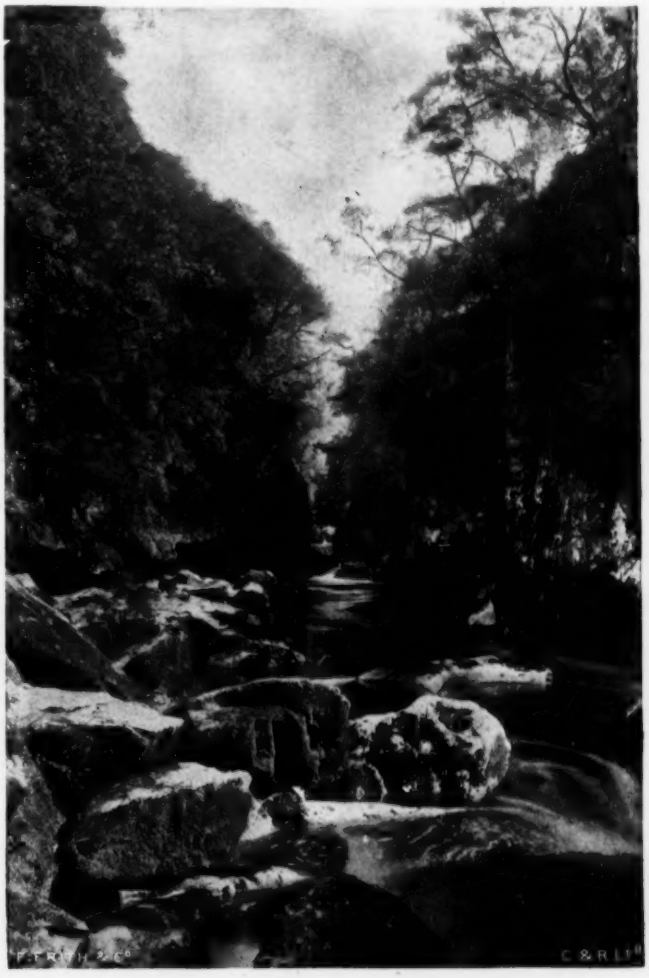
"Bodysgallen" is another very ancient Welsh residence adjoining "Gloddaeth," and now occupied by the Honourable Colonel Henry Mostyn, brother to the present Baron Mostyn. The house may be

seen on Tuesdays and Thursdays from two to four o'clock.

Llandudno is so situated that it can offer the visitor better facilities than any other place on the North Wales coast for excursions either by road, rail, or water. In the season, coaches run every day on the "Loop Tour," a delightful drive of fifty-six miles, through some of the grandest and wildest scenery that North Wales possesses. Those who do not care for a long day on the coach can take shorter journeys to Bettws-y-Coed or Penmaenmawr through the Sychnant Pass; or, shorter still, a drive to Colwyn Bay, returning home through the delightful Mochdre Valley. The trip to Bettws-y-Coed *via* the Conway Valley is highly recommended. One can hardly find sufficient adjectives to describe adequately the scenery of this sylvan paradise. It must be seen to be appreciated, and it can either be reached by half-an-hour's railway ride from Llandudno or on one of the several coaches which drive to it. A special excursion will run on Friday in Easter week to Bettws-y-Coed, and teachers who do not wish to be away from Llandudno for the whole of the day should take advantage of it and not leave North Wales without spending at least a short time there. If this be done they should not fail to see the "Fairy Glen," "Waterloo Bridge," the "Miner's Bridge," and the "Swallow Falls." Its quaint old church should also be visited, which contains an interesting effigy of a knight in armour purporting to represent a nephew of Llewellyn, Prince of North Wales, with an inscription, "Hic jacet Gruffydd ab Davydd Gôch, Agnus Dei miserere." It is suggested that Bettws-y-Coed has derived its name from the church, as the word is probably a corruption of "Bead House" or the "Prayer House in the wood." There are several lovely mountain walks outside the village of Bettws, one of them being "Garth Eryr" walk, up the hill behind the church, which may be followed until Elsi Lake is reached on the heights above.

Another walk is up the Cyran path on the opposite hill, which will take one to Parc Lake and a wide expanse of wild mountain scenery.

Another interesting excursion arranged for delegates, on Friday of Easter week, is to Llanberis, by the L. & N.-W. Railway. After leaving Llandudno and reaching Llandudno Junction, excursionists go in the direction of Carnarvon, passing through Conway, Penmaenmawr, Llanfairfechan, Aber, and Bangor. Departing from Carnarvon, Llanberis is soon reached, and the pleasure seeker finds himself at the foot of Snowdon. A railway runs up the side of the mountain to the top, and delegates will have an opportunity of ascending the "monarch of Welsh mountains" without fatigue. Once at the top, and given a fine bright day, the view obtained defies adequate description. In the distance may be seen the Cumberland hills, the Wrekin, North Pembrokeshire, the Wicklow hills, and the Isle of Man. Every mountain peak of North Wales is visible, besides innumerable valleys and lakes. Those who wish to take the journey up Snowdon need have no fear as to the safety of the tram-road. It is constructed on what is known as the Abt System, which is the most approved system of mountain railways, and it has worked smoothly and successfully for several years. No gradient is greater than 1 in 5½, and, as the speed of travelling is only about five miles an hour, the train can be brought to a dead stop instantly by an elaborate arrangement of brakes. On the return journey to Llandudno, a stop will be made at Carnarvon to give teachers and their friends an opportunity of viewing Carnarvon Castle. This should prove a most enjoyable outing, and can be well recommended to those who wish to spend the whole of Friday away from Llandudno.

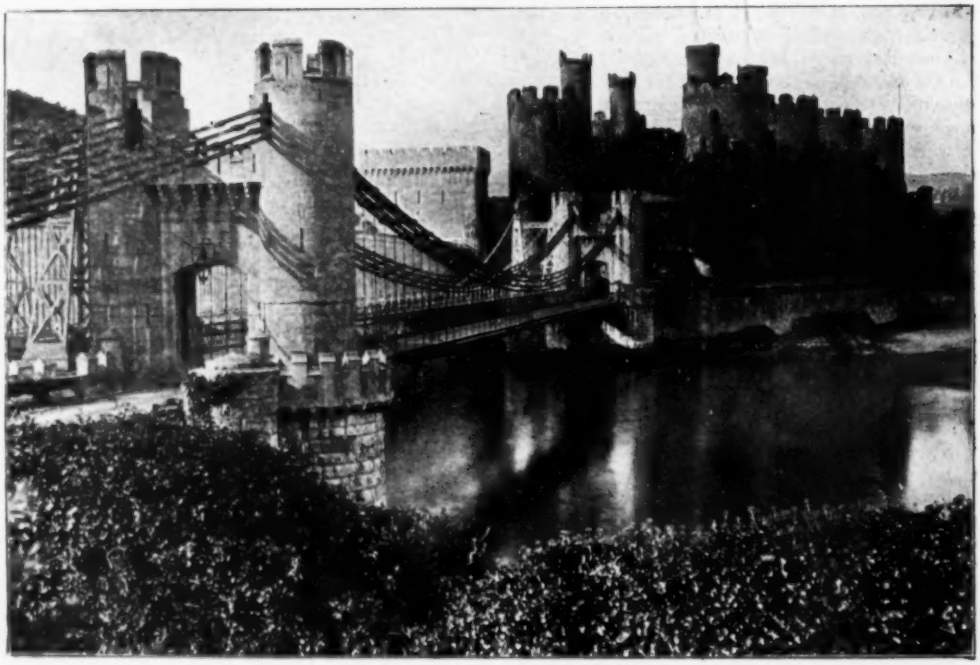


FAIRY GLEN.

The steamboat companies also offer special facilities for visiting places of interest on the coast, one of the most delightful outings being a sail down the Menai Straits. Any of the steamers catering for the excursionists can be boarded at the pier head, entrance to the pier being free if a steamer ticket has been previously purchased. As the steamer leaves the pier, a splendid panorama of the Orme's Head and Happy

Valley is opened up, and expressions of admiration are heard on all sides. After rounding the Orme, the steamer takes a westerly course towards the Straits, passing Puffin Island on its right. Beaumaris, famous for its castle, is soon reached, where passengers are landed or embarked, and once more the journey proceeds. Bangor is the next stop, a very fine view of the Snowdonian range and Penrhyn Castle being obtained on the way down. Those who wish to view the old cathedral at Bangor are given the opportunity of land-

SNOWDON.



CONWAY CASTLE.

ing, while others proceed down the Straits to view the Menai Suspension Bridge and the Britannia Tubular Bridge, both of which connect Anglesea with the mainland. The Suspension Bridge was built by Telford at a cost of £120,000, and the Britannia Tubular Bridge, used for railway traffic only, being on the main line from Holyhead to London, was built by Robert Stephenson, who began it in 1846 and finished it in 1850. The cost of this stupendous structure amounted to the enormous sum of £601,685. Some of the steamers do not go any farther than the bridges, while others continue the journey to Carnarvon. Any one proceeding to the Borough will certainly not fail to it would be a mistake to leave the locality without giving this interesting district a visit.

While in Conway, "Plas Mawr," which is now the home of the Cambrian Academy, must certainly not be overlooked. Its history is sufficient to make it interesting, and those wishing to make themselves acquainted with it, should obtain one of the many guide-books which can be purchased, and in which special notice of "Plas Mawr" is made.

In the centre of the town is a very fine church, dedicated to St. Mary, built on a portion of the ancient monastery of Aberconway, 116 feet in length and 58 feet in breadth. There is a nave flanked by north

TUBULAR BRIDGE, MENAI STRAITS.

visit the old castle previously mentioned, which is in a splendid state of preservation. It stands on three acres of ground, and is 620 feet in length, while its extreme width is about 240 feet. Over the main entrance is a time-worn and weather-beaten figure of Edward I., grasping the hilt of a sword. It is not here intended to enter into a detailed description of the building, but delegates should not miss the opportunity of viewing what is acknowledged to be the finest ancient structure of its kind, not only in Wales, but in the kingdom.

In speaking of castles, it must not be forgotten that another very fine specimen is to be seen in Conway, also built by Edward I. in 1284. To view this, delegates can soon reach the quaint little town of Conway in a very short space of time, as it is only four miles distant from the town of Llandudno. Enclosed by its ancient walls, the town has a very picturesque appearance, and one is led to think, when gazing at the castle, of the days of old, when Edward I. was besieged inside its walls, and nearly starved into submission.

Arrangements are being made to conduct Conference representatives over the castle during Easter week, and and south aisles, a chancel, and a vestry on the north side, a north transept, and two porches. There is a tower of the early English style, containing a clock which strikes the quarters, and a peal of bells. At eight o'clock every week-night, except Saturday, the curfew is rung on one of the bells, sixty strokes being given. On Saturdays this is done at seven o'clock. The interior of the edifice teems with interest, the chief being the rood-screen and the font. The latter dates back to the thirteenth century, and the carving on it is very beautiful. The former is of great antiquity, and is also exquisitely carved. Delegates visiting Conway will find a very full and interesting account of the past history of this ancient church in the guide-book already mentioned.

The town stands on the left bank of the river of the same name, and is connected with the right bank by three bridges. Two of them, the suspension bridge and the tubular bridge, are very similar to those crossing the Menai Straits above Bangor, and were built by the same engineers, Telford and Stephenson respectively. The third bridge is of recent construction, and carries across it the water

mains in connection with the Cowlyd water supply to Colwyn Bay.

Opposite Conway, on the other side of the river, is Deganwy, a suburb of Llandudno, a rising summer resort, and only two miles distant from it. Close to Deganwy are the Alfred Stokes Convalescent Homes, one for men and another for women, the latter being entertained in the historic and secluded old mansion of Marl.

### Colwyn Bay.

A favourite pleasure resort, about six miles from Llandudno, is Colwyn Bay, much frequented by visitors in the holiday season. During the last few years it has grown to a considerable extent, and contains a large number of very wide streets and avenues. At the back of the town, not far from the railway station, are the famous Pwll-y-Crochan woods, through which a most enjoyable walk may be taken, the public having access to them all the year round.

About 1866 there were no houses in Colwyn Bay, but since that time the town has developed in no less a remarkable manner than its neighbour Llandudno. There is a splendid beach of sand, about two miles in length, where one may bathe in perfect safety. Adjoining the sands a promenade, over a mile in length, with numerous kiosks, lit up by twenty-four powerful arc lamps, has been constructed. At the present time it is being extended so as to join the promenade at Rhos, a suburb of Colwyn Bay, about a mile distant from it, at a cost of £15,000. A new pier, with a pavilion, has also been built, and during the summer months concerts are held in the latter place daily. One of the great attractions of the town is "Eirias Dingle," a beautiful and charming walk by the side of a brook, from the shore to the main road. Colwyn Bay abounds with scenery of this kind, and visitors are not slow to take advantage of the lovely spots open to them.

In educational matters Colwyn Bay is not behind other towns on the North Wales coast. Besides its Elementary Schools it possesses a new Higher Grade school, well equipped and up to date in every possible manner. The headmaster is Mr. E. Griffiths, and he is assisted by a very able staff of teachers, one of whom is Mr. S. G. Jones, L.C.P., the treasurer of the General Conference Committee. There are several private schools also in the town, the reputation of which is well known all round the neighbouring districts.

In concluding this article the writer trusts that he has succeeded in arousing the interest of his readers who intend to favour Llandudno with a visit at Easter, and he can assure them that they will never regret having selected the "Queen" of Welsh watering-places, the "Naples of Cambria," for the N.U.T. Conference of 1905.

## THE COMING CONFERENCE OF THE N.U.T. AT LLANDUDNO.

### THE PRESIDENT-ELECT.

Mr. TOM JOHN.

A YEAR ago, one in a quite exceptional position to state his facts accurately, wrote in *The Practical Teacher*: "The chief officer of a Union, now well over 50,000 strong, must necessarily be a many-sided man. He must be sufficiently hardy physically to undertake long and tiring railway journeys to the very extremities of the country, in order to take part in educational demonstrations; he must be robust enough to withstand the strain of lengthy and occasionally weary Executive meetings; he must be ready at every moment to state the position of the Union on any educational or professional question; he must be cognisant of the domestic work of the N.U.T., down to its minutest detail; he must be ready to bear his part bravely and worthily in connection with the multitudinous social functions organised by the local Associations; he must be prepared, during his year of office, to indite replies to thousands of correspondents (the vast majority of whom he does not and cannot know) requiring information and advice on every conceivable subject.

"And during Conference week what a truly colossal task is his! From the eve of Good Friday until the end of Easter week he is literally the cynosure of every eye. His presidential address, sent in advance to every journal of repute in the United Kingdom, must not only palpitate with interest, but be up-to-date, pungent, critical, exhaustive, and a statesmanlike pronouncement on the urgent educational questions of the hour. In the chair of the Conference he must be ever on the *qui vive*, prompt to decide on delicate and ticklish 'points of order'—those eternal nuisances!—tolerant yet not too indulgent to the bores, and ready at any second to deal kindly with the eager seeker after truth. Above all, he must be scrupulously fair, the guardian of the rights of minorities, impressive and dignified from start to finish, and gentle to a fault towards each of the two thousand delegates. He must appear, if only for the briefest space, at every function of the week, and make short, pithy speeches wherever he goes. Twenty-five or thirty addresses is the minimum which falls to his lot. Finally, he must have the good fortune and felicity to be supported by a helpmate whose presence will lend grace at every turn, and who will be responsible for many charming little acts during the course of Conference week."

A stupendous task, indeed, is that which awaits Mr. Tom John, the great Welsh protagonist. Yet 'tis one from which having put his hand to the plough, he will not turn back. In the fierce struggle for supremacy, in the early months of 1904, his many friends delightfully dubbed him "The Veteran," and worthily has he earned the cognomen. He became a member of the National Union of Elementary Teachers—as it was then called—three and thirty years ago, or about the time when some of the most promising of to-day's Union leaders were in their cradles. Fifteen years later, he was elected a member of the Executive at the first Portsmouth Conference, and it was perhaps a little singular that his next great success should occur at the second Portsmouth Conference. When he first became a member of the Executive, the numerical Union strength in Wales was measured by 500. To-day, it runs well into the fourth thousand; and the gallant little principality is ever ready to bear abundant and universal testimony to the great part Mr. John has taken in this successful and aggressive campaign, and justifiably and most willingly to apportion to him the lion's share of the honour.

It is not particularly easy, to-day, for the new-comer to obtain an official position at the Executive, and it was still more difficult two decades ago, when Mr. John first joined the elect. Yet, so highly were his earliest

fellow-members impressed by his zeal and organising ability, that, as far back as 1889, he was made Vice-Chairman of the Organisation Committee, and the following year he became Chairman, and held the position for five years. Then recognising, like the wise man he is, that one's ideas on organisation can be worked out, and that a new man can very probably introduce new notions calculated to succeed in their turn, he relinquished the chair of the Organisation Committee in order to become the Vice-Chairman of the Parliamentary and Superannuation Committee. In this position he rendered most effective and valuable service, his friendship with the members of an influential political party being not only a joy to himself, but a substantial benefit to his fellow-Unionists. After four years' official connection with the Parliamentary Committee, he succeeded to the chair of the Law Committee, where admittedly his best work was done. The details and technicalities of legal cases are not particularly interesting to the layman at any time; but all through 1902 and 1903, Mr. John's devotion to his duties never wavered in the slightest degree. However lengthy and intricate the cases seemed to be—and it was no uncommon thing for a hundred separate cases to come under review at a single sitting—he never evinced the remotest symptom of weariness or failing interest. Ordinary members might excusably overlook the details of cases here and there, but this could not be said of the chairman, who, as the months rolled on, added to the already great reputation he had won. When, last Easter, he was elected to the Vice-Presidency of the Union by a magnificent vote (16,855 fellow-teachers exercising the franchise on his behalf), Mr. John retired from the position he had filled with so much distinction to himself and benefit to the Union. This withdrawal was in accordance with Russell Square custom, although, needless to add, there is no rule dealing with the matter.

For very many years Mr. John was the only Welsh representative on the Executive, and during that period he was entrusted with the investigation of countless cases of dispute and difficulty between members of the Union and their employers. His great sympathy with the distressed, his ready wit, his exceptional knowledge of Welsh character and national life, his personal prestige amongst all classes of his fellow-countrymen, rendered him a peculiarly appropriate ambassador of peace and goodwill. Scores of teachers throughout Wales have to thank him for the energy, tact, and resourcefulness he ever showed in dealing successfully with the numerous tenure cases that he had in hand.

Nearly a year ago, *The Welsh Leader* included Mr. Tom John in its series of "Welsh Leaders of To-day," and, in the course of a highly appreciative sketch, said: "To him the profession has appealed so much more strongly than any other influence, that it has become, in a sense, the Alpha and Omega of his faith, the be-all and end-all of his works. His Confession of Faith, if reduced to concrete form, would possibly be found to consist of a single article embodying the belief that the Schoolmaster has been pre-ordained to receive all honour and to exercise all power." The *jeu d'esprit* is amusing enough, and contains more than a *soupçon* of truth. For, all his life, he has made constant and unceasing efforts to raise the status of the teachers in primary schools. His own presence on the University Court of Wales, the Central Welsh Board, and the University College of South Wales and Monmouthshire, has naturally been of enormous value to the teachers of the Principality, whilst it is largely due to his individual efforts that the primary teacher has received recognition on these educational bodies. Possibly no better evidence of the high esteem to which his sterling personal qualities entitle him can be adduced than the fact that he has been elected to the Executive Committees of both the University Court of Wales and the Central Welsh Board.

All men chosen to lead must have necessarily a "programme," and, as a matter of interest, we include that of Mr. John, issued twelve months ago:—

1. A National System of Education, with the abolition of Denominational Religious Tests for Teachers.
2. Teaching a Profession, with a Professional Code of Honour.
3. One Register for all Qualified Teachers, and an open Inspectorate.
4. Amendment of the Superannuation Act, so as to secure a Lower Age of Optional Retirement and an Increased Allowance.
5. Fuller Recognition of the Status and Responsibility of the Class Teacher, with:—(*a*) Full Powers of Discipline; (*b*) Smaller Classes; (*c*) Worthier Remuneration.
6. The same scale of Salaries for Infants' Mistresses as for Girls' Mistresses.
7. A More Generous National Recognition of the Special Difficulties of Rural Schools.
8. Training College Accommodation for all Teachers seeking the Certificate.
9. Retention and Improvement of P.T. Centres.

If Mr. John, when he elects to lay aside his armour, has the good fortune to see a moiety of the above reforms effected, he will be able to go into retirement a happy man.

The noblest phase of the work of the National Union of Teachers—its charities—has ever commended itself to Mr. John. He is a Vice-Patron of the Benevolent and Orphan Fund, a distinction worthily gained by his extraordinary effort on behalf of the Widows and Orphans for the Cardiff Conference, when he, almost single-handed, raised the splendid sum of £1700.

Notwithstanding all his professional labours, he has found time—like many other busy executive members—to devote attention to public work. Founder and Secretary of the Mid Rhondda Chamber of Trade, Editor of *The Glamorgan Free Press*, and now of *The Rhondda Leader*, he has had his hands full. But not full enough, for he must needs take to the duties of choirmaster as well, and has made for himself and choir a great reputation. Mr. John's many-sidedness was aptly alluded to in an address, presented by Sir Thomas Marchant Williams on behalf of the old boys of "Ysgol Comin," Aberdare, at a complimentary banquet held shortly after his accession to the Vice-Presidency. We have space only for a sentence or two of this remarkable address:—

"We recognise your courage, persistency, and devotion to duty, and also the appreciation of the members of your profession. The high and responsible position to which you have been elected has been occupied by very eminent men, but we feel certain that the Old Boy of Ysgol Comin will add new lustre to the chair which he will occupy at Llandudno next Easter. In addition to your many offices in connection with the N.U.T. as Chairman of Committees, &c., &c., your public work has been varied and useful. Literature, music, the eisteddfod, and local industries, have found in you a staunch supporter. Withal you found opportunity to attend to social and religious work at home, and we are gratified to know that this has not been unappreciated by your immediate neighbours in the Rhondda Valley."

We divulge no secrets when we state, in concluding this sketch of Mr. Tom John, that throughout the past year his services as intermediary between the Welsh Bishops and the leaders of the Welsh National Party have been literally invaluable. His sincerity and single-heartedness have secured the confidence of both contending parties, and if an educational war in the Principality be finally averted, no small share of the credit will be due to him. In the chair at Llandudno, he will probably prove to be a President *sui generis*, and the universal hope will be that "the perfervid eloquence, the acute reasoning, and the Keltic imagination of that prince of Welsh orators, Mr. Tom John" will not be entirely overshadowed by the restraint that this experienced gentleman may deem necessary to his exalted position. Mr. Sharples was a magnificent success last year, because, in the chair, he dared *to be himself*. Why should not Mr. Tom John dare, and succeed, in similar fashion?

## NOTES FROM THE NORTH.

***The Presidentship of the Institute.***

THE Institute has not yet taken the leaf out of the book of the National Union of Teachers, which says that the Vice-President of one year shall be the President for the succeeding year. We have usually a contest for both positions, and this year is no exception to the rule. Whether the day will come or not when we shall rest satisfied with one election, it is very evident that we are at the present time very far from it. That there is considerable dissatisfaction with the present method of nomination goes without saying, and various suggestions have been made in different quarters with a view to remedying this state of affairs. More than one committee of the Institute has had the matter before it, and at the present time the Special or Executive Committee is tackling the subject, but from all indications it appears that we are still a long way off a satisfactory solution. The interest in the Presidential election is by no means very pronounced, for out of over 6000 members last year, only some 3600 thought it worth their while to record their votes.

Of the two unsuccessful candidates in last year's election, one again offers himself this year. Two candidates have entered the field for the first time, and it may be of some interest to the members of the Institute and others if we give a short sketch of the professional career of the aspirants for the "Blue Ribbon" of the Scottish profession.

Mr. John M'Kenzie, F.E.I.S., the head-master of Ashley Road Public School, Aberdeen, has been again nominated by his own local association. A native of Banffshire, he entered the service of the Aberdeen School Board as a class master, and now occupies the position of head-master of one of the leading public schools of that city. For the last twenty-seven years he has been a member of the Institute, and during the greater part of that time he has taken a prominent and active part in the work of the Aberdeen Association. Mr. M'Kenzie has held in succession the offices of Secretary, President, and member of committee. For a number of years he has been continuously returned as a member of the general committee of the Institute, and on several of its sub-committees, especially the Benevolent and *Educational News* (of which he was convener), he has done valuable and faithful work. To his efforts is due in large measure the fact that the Institute now possesses the controlling power on the directorate of the *Educational News*.

Mr. M'Kenzie has on more than one occasion acted as the representative of the Institute on deputations. When the Institute had six Vice-Presidents, he was one of its Vice-Presidents for three years. He also had the honour of being selected by his Board to give evidence before the Royal Commission on Physical Training. Last year he was runner-up and secured 940 votes. As we said in our sketch of his career last year, his broad

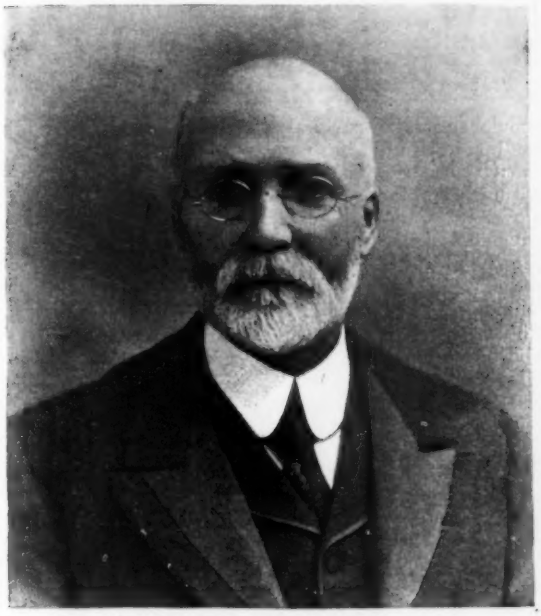
MR. JOHN M'KENZIE, F.E.I.S.

and liberal views on educational questions, his experience and energy, make him in every way well qualified for the position of President.

Mr. John Mudie, F.E.I.S., the head-master of Glebe Lands Public School, Dundee, who is the nominee of the Dundee Local Association, is a native of that town. On completing his Training College course he became head-master of an important denominational school in Stockton-on Tees. During his tenure of that office he was chosen as one of the delegates to the first York Conference of the N.U.T. After five years' successful work in Stockton, he was appointed head-master of Princes Street Public School, Dundee, and when the new Glebe Lands School was opened he became its head-master. During his occupancy of that position, the school has been twice enlarged, and now claims to be one of the largest schools in Juteopolis. For more than thirty years Mr. Mudie has been a loyal and enthusiastic member of the Dundee Association, and has filled the offices of President and Secretary, the latter of which he has held for ten years. In the earlier years of his connection with the Institute, he inaugurated and directed, under the auspices of the Local Association, the "Association for the Promotion of the Higher Education of Pupil Teachers." Mr. Mudie also acted for some time as the President of the Head-masters' Association of his native town. For several years he has been a member of the general committee, and has especially taken an active part in the work of the special and finance sub-committees. At present he is one of the Institute's representatives on the directorate of the *Educational News*. He represented the Institute at the Irish Congress at

Londonderry some years ago. His sound business qualities, his administrative ability, and his common sense mark him out as one likely to fill with great acceptance the Presidentship of the Institute.

The Hamilton Local Association have brought forward a third candidate in the person of Mr. William Service, M.A., B.Sc., J.P., the head-master of Coatbridge High School. His professional career was begun in Kilwinning Parish School, Ayrshire, to which place he returned as a class master after successfully completing his studies at the Glasgow Church of Scotland Training College and University. After some time in that position he became classical master in Park School, Glasgow, from which he proceeded to George Watson's College, Edinburgh, as one of the senior masters. In 1876 Mr. Service was appointed head-master of Victoria School, Airdrie, and ten years later obtained his present position. For nearly thirty years he has taken a keen interest in the work of the Institute, and, like the other two candidates, has been a member of the general committee of the Institute. The highest offices in his local association, too, he has filled with great acceptance. Last year he represented the Institute at the Irish Congress at Belfast. His ripe scholarship, his wide experience of the various



Mr. John Mudie, F.E.I.S.

grades of schools, his urbanity and kindly manner, warrant the hope that if elected he will fully maintain the high dignity of the office.

* * *

***Training of Teachers.***

As I anticipated in last month's notes, the Minute dealing with this important subject has met with very considerable acceptance, or, perhaps it would be more correct to say, it has experienced little or no opposition. The Institute suggests one or two amendments, which it believes are in consonance with the tenor of the Memorandum and Minute. It desires to see the University element substantially increased, and that among the added members there should be an adequate proportion of women representatives. The only note of opposition the Institute raises is to deprecate strongly the institution of subsidiary courses of training at approved centres in connection with a secondary or a higher-grade school. The Institute wishes students to

Mr. William Service, M.A., B.Sc., J.P.

attend one or other of the University centres and there go through the full course of training, and does not consider that the training to be given at these centres can possibly be satisfactory or adequate in itself. To my mind the institution of these courses would lead to the introduction of less qualified teachers, and consequently would accentuate the present anomalies.

Lord Balfour of Burleigh, the late Secretary for Scotland, who is evidently a churchman first and an educationist after, has given notice that he will call the attention of the House of Lords to the Minute, and will ask the Vice-President of the Committee of the Council a series of questions as to whether the transfer of the Training Colleges will in all cases be permanent and irrevocable, what ground there is for the permanence of the policy of the Minute, and whether the representatives will be chosen by the body described as "the Church or denomination" or by the Committee.

* * *

***Education Bill.***

THE Scottish Education Bill has been reintroduced in form very much like its predecessor. Some concessions here and there have been made to the weight of public opinion, but the principle of the two Bills is the same. The text is not before me as I write, and consequently I am not able to discuss some of the changes, especially those relating to the larger powers to be bestowed upon the Provincial Councils. As was to be expected, the question of rating has undergone considerable modification, but I am not certain that the Government has yet taken the fairest method. It is

suggested that the debt for purely secondary educational establishments shall be spread over the whole district, but that each parish shall retain the burden of existing and future debt for its own elementary schools, the cost of maintenance of all being, of course, distributed over the district. I am not convinced that this is a more equitable arrangement than that of last year's Bill. Why cannot our legislators take the simplest means and make the district bear all?

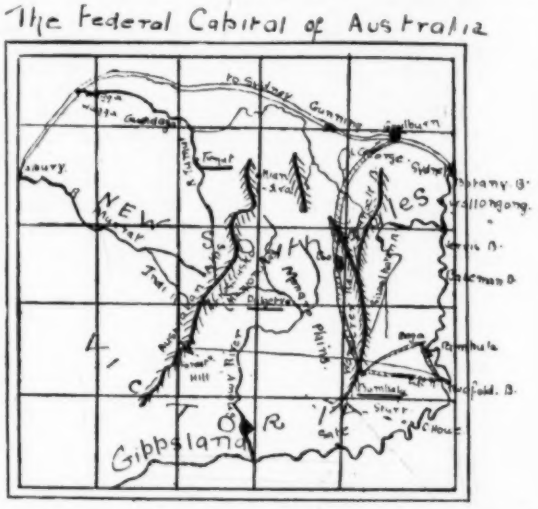
PROFESSOR DARROCH, of Edinburgh University, delivered a most interesting address on this subject recently, and I have been favoured with a copy of the address, which has just been published. There can be little doubt that the recent Minute on the Training of Teachers has brought the question of reform within the region of practical politics. The need of a Faculty of Education is one that ought to be emphasised at the present time. The Institute is engaged in discussing the subject, and it is to be hoped that they will give the result of their deliberations at an early date. Probably the powers to be given to the new Provincial Councils will go far to remedy the present anomalies in our University system, and to Professor Darroch is due the best thanks of the profession for his efforts in calling attention to these anomalies. His words of warning at the close of his address are worthy of consideration. "If," he says, "the Universities of Scotland at the present important juncture in our educational affairs, either through apathy, or indifference, or inertia, allow this opportunity to pass of inaugurating much-needed reforms in the reconstruction of their courses of study, in the better reorganisation of their methods of instruction, and in meeting the new demands of the time, then they will have themselves to blame if much of the instruction which should be provided by them be increasingly sought for elsewhere."

***Reform of the Scottish Universities.***

## THE FEDERAL CAPITAL OF AUSTRALIA.

AFTER much wordy warfare, the Commonwealth of Australia have by the Seat of Government of the Commonwealth Act, 1904, fixed the capital site at some place within seventeen miles of Dalgety. Other rivals for this proud position in one of our most important colonies have been Bombala, Lyndhurst, Tooma, and Tumut. It appears, however, that New South Wales has been subjected to the exclusion of the capital from any spot within 100 miles of Sydney, and is therefore, by way of protest, making her voice heard in the matter. According to the most recent interpretation of the "seat of Government" Act, an area having Dalgety as its centre, with a radius of seventeen miles and containing a little over 900 square miles, must embrace the future Federal Capital of Australia, while, on the other hand, we have the highest legal opinion, viz., that of the Attorney-General, Mr. Wade, and Sir Julian Salomons, that this area has to be acquired by the Commonwealth before the seat of Government is fixed. The highest mountains in Australia, *i.e.* the Australian Alps, are in close proximity to Dalgety (see diagram), and the Snowy River, which is also quite near, possesses a volume of water which is unequalled as a permanent source of water-supply. Dalgety has the further advantage of occupying a most central position.

Better known perhaps as Buckley's Crossing, the capital site which has received an overwhelming majority of the votes of the representatives of the other States (New South Wales excepted), is situated in a corner of one of the oldest settled but least




populous of the pastoral districts, remote from all leading centres of business and industrial or administrative activity, and at the same time void of any natural advantages or sources of wealth for the employment or support of population. It has the disadvantage, besides, of being difficult of access from all the neighbouring states, and entirely without the accommodation even for the workmen who would be employed in the erection of necessary public buildings. The elevation being about 2500 feet, some 400 feet above Goulburn, and over 100 miles to the south, the winter climate is rigorous, and at times severe; whilst its severity is not mitigated by winds from the neighbouring Snowy Mountains.

The Margalong or Snowy River, which waters the district of the southern slopes of the Australian Alps, and flows to the sea direct, has its upper course in New South Wales, and its lower in the Gippsland portion of Victoria. Situated at the crossing of this river on the old stock route to Gippsland (practically the only approach to the State of Victoria), the new capital is cut off from the south-western districts by the Australian Alps and broken country forming the most elevated part of Australia. The latter is covered with snow for a considerable period of the year, when even the round-about and mountainous road *via* Kiandra and in the direction of Tumut is not available, and except from the sea, *via* Bega, Pambula, or Eden—not less than some 100 miles by road—the only available access from other parts of the Commonwealth is by the southern railway through Goulburn to Cooma, and thence by road some thirty-five miles. This latter is, and must unquestionably be, *the "way to"* Dalgety for very many years, unless a line of railway suitable for fast passenger traffic, not less than seventy-seven miles in length, from Cooma, *via* Dalgety, to the Victorian border, is constructed, at a cost, approximately, of a million and a half of money.

*The Topographical and Geographical Illustrations are specially attractive and interesting. This shows the Boulevard St. Denis, Porte St. Martin.*

# THE HARMSWORTH ENCYCLOPÆDIA.

"OF making books there is no end, and much study is a weariness of the flesh," was the opinion of the Eastern sage some thirty centuries ago, long before the era of the rapid printing press and the age of cheap literature. What he would have said in these latter days is doubtful, but most probably he would have added, "therefore, my son, give up trying to learn anything and get thee an Encyclopædia."

The development of national education throughout the world, the researches into the mysteries of every branch of nature, the rapid communication which makes all educated peoples one, the multiplication of books at a trivial cost containing the wisdom and knowledge of the wisest in all ages, have together produced such a bewildering mass of useful information that it might well appal the wisest sage even if he had ten centuries of life before him and all the volumes of the British Museum in his library.

Beyond a cursory acquaintance one cannot expect to know very deeply more than the one or two subjects which may occupy the spare moments of a lifetime, and yet it is absolutely essential that any one claiming to be well educated according to the world's modern standard *must* know something of the thousand and one terms, names, references, &c., which confront him in the pages of the newspaper or magazine.

It was in the endeavour to cope with this difficulty the Encyclopædia had its birth. To gather together the sum of human knowledge into a comparatively small number of volumes was a bold idea, and yet it has been only fairly successful, for comparatively few people possess such a compilation.

What are the common objections urged against the Encyclopædias on the market? Briefly, I take it, they are: (*a*) "An Encyclopædia is a white elephant. You buy yards of type where you need only inches." (*b*) "The price is prohibitive to the man or woman with a moderate income." (*c*) "Any information you want on a topic may be easily obtained from a text-book." (*d*) "I don't want it."

The *Harmsworth* supplies complete and convincing answers to these objections.

Taking them seriatim. (*a*) The *Harmsworth* occupies just the right position between the dictionary which tantalises by the brevity of its explanations and the heavy tomes which crush one with their ponderous weight. The average man who wants to know something of a modern writer is amply satisfied with ten to twenty lines containing the chief points of his style and his chief works, and does not require to know whether he has had the measles or what colour is his hair. Or let us take an example from history. Who was Aidan?

"*Aidan, St.* (d. 651), a Columban monk of Iona, where he was consecrated bishop about 635, in which year he began his work of christianising Northumbria in response to the invitation of Oswald, King of Bernicia. Fixing his see at Lindisfarne (the Holy Isle), Aidan founded there the church afterwards associated with St. Cuthbert. King Oswy, brother and successor of Oswald, continued to act as Aidan's patron until the latter's death. Bede testifies to the piety, humility, and fervour of the apostle of Northumbria."—See *M'Lauchlan's Early Scottish Church* (1865); *Bede's Ecclesiastical History.*

There is the whole thing in a nutshell! The articles are short, but full of information; condensed, yet clever and interesting. If you want to know more, you will find at the end of each important article a list of the best books on the subject.

(*b*) You are not asked to send along a large cheque for this Encyclopædia; the price is within the reach of all—7d. per fortnight, one halfpenny per day—the price of the evening paper you look at for five minutes and throw away. It will be complete in forty parts (eight volumes), so that the total cost will be but little over £1. Further, you will get 6400 pages and 50,000 articles, or about 180 articles for 1d. As it is issued, the cost is comparatively nothing, and the result is the acquisition of a valuable reference library.

(*c*) Of course you get fuller explanations in a text-book! But are you prepared to buy the thousands of text-books necessary? If so, you work under an authority whose salaries are high!

(*d*) "You do not want it?" I am afraid you cannot do without it, or its equivalent, if you wish to keep up with modern thought. If you propose to vegetate and let your brains lie fallow, of course the book is useless to you—as are all books.

*Scientific and Natural History Subjects are profusely and adequately Illustrated.*

There are several other points which should appeal especially to the teacher who aspires to be one of "the captains and guides of the new democracy." He can hardly do this if he is not up to date. This is one great quality of the *Harmsworth Encyclopædia*—it is revised and posted up right down to the time of going to press.

Again, the book is reliable. It has been compiled by the cleverest men of the day. You can rely on the opinions of such men as Evelyn Abbott, Professor Adams, Sir W. Besant, Sir William Clowes, Professor Rhys Davids, Edmund Gosse, Andrew Lang, G. F. Stout, Professor Petrie, Professor Saintsbury, Clement Shorter—to mention only a few of those who have helped in the production.

The illustrations are particularly helpful. Profuse in quantity they are nevertheless works of art, and teach as much as the letterpress in many instances. Turn to the sketch of the Acropolis. No amount of reading will produce such a lasting impression of the concentrated architectural beauty of Grecian buildings as one obtains from this view.

Do you want the matter for a lesson on radium, on wireless telegraphy, on some flower, on the process of some manufacture, on the life of some great man, on the geography of some country, etc.? Or do you want the outlines for an essay on any common topic? Do you want an up-to-date map of any part of the earth? Do you want a book which you may pick up and read with interest at any odd time? If so, you may have what you want at a lower price than has ever been offered to you.

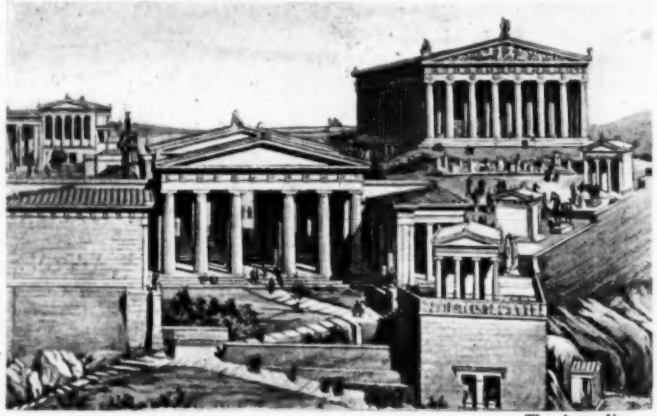
We venture to think that the *Harmsworth Encyclopædia* will be a special boon to the pupil-teacher, especially in connection with the General Knowledge paper set at the King's Scholarship Examination. Frequently consulted, it will enable the candidate to defy even the trickiest of examiners. Every individual question set in the paper last December can be answered fully and accurately from its pages. Indeed the Encyclopædia is invaluable to every teacher who is preparing for an examination, no matter what its scope. It is a Classical Dictionary, a Gazetteer, a Compendium of Modern Science, Art and Technics, a Manual of Universal History, Biography, Law and Literature, and a guide to Social and Industrial Movements, all rolled into one.

*J. M. Barrie.*

*An outstanding feature of the* Harmsworth Encyclopædia *is the large number of portraits of famous people, living as well as dead.*

I think the readers of this journal will admit that they have never seen anything recommended in its columns which has not, upon examination and trial, justified the commendation, and therefore they may rely upon this—that the *Harmsworth Encyclopædia* is the best and cheapest book that has ever been offered to them, and that if they buy Part I. they will most certainly look forward with pleasure to the issue of the succeeding numbers.

Next month we hope to announce a series of prize competitions in connection with the issue of this Encyclopædia. The competitions will be graded in difficulty and varied in character, and will afford an intelligent and interesting occupation for all classes of our readers. Meanwhile, as this work is a distinct contribution to popular education, we would appeal to all our readers to assist us in making the *Harmsworth Encyclopædia* known to their colleagues and the general public.



*The Acropolis.*

*Art, Archæology, Antiquities, History, etc., are all fully Illustrated.*

# OUR CLASSROOM AIDS.

## NATURE NOTES FOR THE MONTH.

### SPRING MIGRATION.

#### Signs of Spring Migration.

THROUGHOUT the world, the merging of winter into spring is signalised by a series of striking changes which take place amongst the bird population of the various countries. In our own little island we have ample evidence of spring's return, without having recourse to the calendar. During the winter months the feathered population has been more or less stationary, though one cannot expect individuals of such a restless temperament to confine themselves to one fixed locality. There have been numerous internal movements due to local changes, and chance travellers from abroad have occasionally dropped in, but, comparatively speaking, ever since the great autumn migration the birds have remained in a state of simmering quietude.

Of late, however, the aspect has altered considerably. With regard to the residents, we notice the dispersal of the winter flocks.

The effect of spring's return is even more marked in the case of the winter migrants. Down by the shore, the little parties of aquatic birds which frequented the estuaries, and provided sport for the gunner, have scattered and departed; the ranks of the waders have thinned perceptibly. Only this morning when walking round Leadenhall Market I was forcibly struck by the meagre display of birds. At the time of writing (March 1st) the fieldfare may still be seen in the rural districts round London, but, judging from the reports of observers, these and other interesting birds are not so frequent as formerly in the Southern districts. On the other hand, we are informed that the counties adjacent to the North Sea are packed with winter migrants, evidently the absentees from the South. These signs indicate a great spring departure, and one significant of an exodus towards the north.

In this respect our island does not stand alone. Far to the South in the Equatorial regions a similar movement is in progress; certain birds are departing over the northern boundaries.

Later on, perhaps by the end of March, the sheltered lanes of Devon and Hampshire will resound with an absurd little melody emanating from an insignificant little brown bird with a dingy-yellow breast, whereupon we may rest assured that the balance of bird life is about to be restored.

The great influx of summer migrants, of which the chiffchaff is but the forerunner, begins in the middle of March, and reaches its maximum of intensity by the middle of April, after which it gradually dies away as the birds settle down to domestic duties.

The new arrivals are an interesting body of birds, and compare favourably with the departing guests. The very fact of their being harbingers of summer is sufficient to endear them to the heart of the average person; moreover, on the whole, they evince but little fear of man.

The swallows resort year after year to the same dilapidated country chimney, and the spotless house-martins persist in plastering their nests under the eaves in spite of the good housewife's broom.

The majority of the birds feed on an insectivorous diet, consisting of flies, caterpillars, and other minute forms of life injurious to the crops, hence they should be protected, if only from utilitarian motives. Some of them are exceptionally good musicians. The nightingale, blackcap, garden-warbler, and tree-pipit can hold their own with many of our resident songsters, so on the whole the birds now taking possession of our fields and orchards are a decided acquisition.

#### Cause of the Movement.

In order to gain an insight into the origin of this wonderful movement it is necessary to hark back to previous events.

Last autumn, a great movement took place towards the South. Birds which otherwise might possibly have remained residents in the higher latitudes, were compelled by circumstances—the return of winter with its attendant hardships—to forsake their native haunts and seek temporary quarters elsewhere.

The movement originated in the Arctic regions in the month of August. As winter extended its influence, it became general over the whole of the Northern hemisphere, each feathered refugee seeking a hospitable land in the South, wherein to eke out an existence, pending the arrival of better times. Our delicate insectivorous birds went to the Southern hemisphere,

whilst we in turn received an influx of hardy habitues of the frozen north. The good time is now arriving, owing to the inclination of the earth's axis.

Spring migration is the reaction of the autumn movement, the flow of the avian tide, and is primarily due to the re-awakening of the breeding instinct.

With the exception of the pigeon and other species domesticated by man, all birds have a fixed breeding season. During the remainder of the year they evince no desire to propagate, indeed the sexual organs lie dormant, as may be easily verified by dissection; but whilst the impulse is upon them, all other matters become of secondary importance.

Added to this they have an inherent love of home, and a natural inclination to rear their young in the locality where they themselves were successfully brought up.

Hence the feathered exiles wintering in Africa, England, or India, as the case may be, prompted from within, and warned by the changing surroundings that spring is at hand, hasten to return to their breeding grounds in the North. They hasten literally, in comparison to their previous performance; as we learn from the testimony of Seebohm and other ornithologists.

At its southernmost point of influence—Cape Colony—the migratory movement begins in February. As the pioneers move northward in easy stages, they are joined by others, consequently when the vanguard crosses the Equator (at the beginning of March), the wave of bird life has assumed considerable proportions.

The majority of the migrants alight finally in April at various places in the North Temperate Zone; the remainder, which constitute the "birds of passage," pass over in gradually diminishing numbers, reaching their Arctic homes in May.

### Routes and Incidents.

In a previous paper (December) there was a description of the manner in which the migrants went South. Though it has been stated, on the authority of observers stationed in various parts of the Old World, that the lines to and fro between the winter and summer quarters do not necessarily coincide, there is no doubt that the spring journey is more or less a replica of that of autumn, inasmuch as there are obstacles of the same nature, and consequently similar precautions to be observed.

The birds have certain recognised and well-worn routes along which they travel.

This is partly due to a providential instinct inherited from generations of experimenting ancestors, but the precautions which the modern bird must necessarily adopt are in a measure responsible for the regularity of the lines of flight.

"Precautionary measures" are dependent on two factors: individual characteristics and habits, and the nature of the obstacles to be overcome.

A great number of the warblers, as typified by the whitethroat, garden warbler and others, winter in Cape Colony, and from the south of the continent to their English homes is no slight journey.

Suppose, for the sake of argument, we take a map and see how they will proceed. The whitethroat, as we know him, is an insect eater, an arrant skulker in the tangled herbage where he gets his food; moreover, he has short rounded wings compared with the swallow and others, and so does not indulge in long flights like his fellow migrant.

Bearing in mind these characteristics, if we look at the map we notice that two great obstacles confront the returning birds, the Sahara and the Mediterranean. All discriminating whitethroats will avoid crossing this broad waterless expanse, which stretches practically from the Atlantic to the Red Sea; those rash individuals who were venturesome enough to experiment, would, in all probability, have no opportunity of transmitting their experiences to posterity. They must find a gap. Theoretically, we might expect the solution of

Map giving a rough idea of the winter quarters of a few European summer migrants (according to Bowdler Sharpe), and the routes by which they arrive.

the difficulty to lie in the Nile, with its fertile borders teeming with insect life.

As a matter of fact, the ancient river of the Pharaohs has always been a recognised bird highway. Its general direction alone is favourable, and, stretching as it does far into the South, its numerous feeders, converging from the interior, with their complements of rank vegetation and insect life, insensibly guide the tiny migrants to the gate of the Sahara. Furthermore, the great waterways of Africa, the Zambesi, Congo, and others, all serve to attract the scattered migrants in the right direction.

Having reached the fertile slopes of the North in safety, the next barrier is the Mediterranean. Those of the migrants native to Asia avoid this by journeying *via* Palestine. The Psalmist was inspired by the "voice of the turtle," a migrant pigeon, as we shall see later on.

European birds, including those native to Britain—a goodly number at this stage—must cross the sea, and here again the majority of the birds, particularly those with short wings, observe the same precautions. Wher-

ever the circumstances are favourable to short flight, there assuredly the migrants gather.

Jutting promontories, and headlands, and chains of islands are well patronised. The rock of Gibraltar, the island of Malta, and the Grecian Archipelago, have long been famous in the annals of ornithology—this we can readily understand by glancing again at the map.

Once in their native continent, the migratory streams divide still further, and proceed, as explained in the paper on "Winter Migration," up the coast and river valleys, subdividing and dropping small parties as they pass through the various districts.

Our own visitors naturally strike across the Channel to the southern coasts of Kent, Hants, and Devon, and it has been stated that the males arrive first, perhaps because they are the stronger birds.

From personal observation, I can quote several experiences in support of this statement. Every year, at the end of March or beginning of April, numbers of wheatears appear in Richmond Park. I have noticed that the first arrivals are invariably males, characterised by the slate-blue backs and conspicuously white rumps. At times, as many as six or eight may be seen on the rabbit warren, all males.

I have noticed the same thing in connection with willow wrens and nightingales, which annually visit (the former birds actually stay and breed here) Wimbledon Common.

One fine morning in April 1903 the birches were alive with the former birds, and, strange to say, practically every individual to be seen was indulging in its lilting song, a sure indication of the sex. The fact of the males arriving *en masse* before the females, is doubtless the reason why the chiffchaff and other birds are so well known.

Before leaving this subject there is another interesting fact to be recorded. The majority of the migrants moult preparatory to setting off on their homeward journey. Those who do not moult completely shed their wing quills—a wise provision of nature, which ensures the bird being in the best condition for its long flight.

In some cases, however—the plover and allied families, for instance—the body feathers of the nuptial dress, which is totally different from the drab winter covering, are partially assumed *en route*.

The knots, which passed over last autumn and made their appearance occasionally at Leadenhall Market, had white breasts, but if we could examine the same birds when they are returning, we should find that the white is being replaced by a rich chestnut.

Appended below will be found a table giving particulars concerning some of our best known summer visitors, and, roughly, their times of arrival. Many other interesting items might be chronicled, but now that the spring migration has fairly begun, a series of country rambles will prove much more instructive than pages of printed information.

**Summer Migrants.**

WHEN, WHERE, AND HOW TO DISTINGUISH THEM.

| BIRD. | ARRIVES (approx.). | DEPARTS (approx.). | HAUNTS. | DISTINGUISHING CHARACTERISTICS. | |
|---|---|---|---|---|---|
| | | | | PLUMAGE. | HABITS. |
| Wheatear . . . | March, April. | Sept. | Grassy downs, hillsides; ploughed land in autumn. | White rump conspicuous; slate blue back. | Short reluctant flight; perches on clods. |
| Redstart . . . | April. | Sept. | Orchards (hollow old trees). | Red tail. | Tail continually shivering. |
| Nightingale . . | April. | Sept. | Dense copses, particularly near water. | Modest; red back. | Song; retiring disposition. |
| Whitethroat . . | April. | Sept. | Hedges—"nettle creeper." | White under parts. | Aggressive demeanour, ruffled head and throat; jerky little song and flight. |
| Blackcap . . . | April. | Sept. | Woody copses; plantations. | Male—black head. Female—brown head. | Song. |
| Chiffchaff . . . | April. | Sept. | Orchards. | Dingy yellow under parts; feet—*black*. | Erratic note; unobtrusive demeanour. |
| Willow Wren. . | April. | Sept. | Orchards. | Bright yellow under parts; feet—*brown*. | Creeps amongst small boughs. |
| Yellow Wagtail . | March. | Aug. | Pastures ("field" wagtail). | Canary yellow; long tail. | Restless disposition; frequents cattle; tail motion. |
| Red-backed Shrike | May. | Aug. | Tall hedges on hillsides. | Male—rosy-tinged breast; black "moustache." Female—grey breast; sober plumage. | Perches conspicuously on hedge-tops; exclusive and solitary disposition. |
| Flycatcher . . | May. | Sept. | Orchards. | Grey breast, slightly spotted. | Coign of vantage; short flight; aerial eccentricities; return c.o.v. |
| Swallow . . . | April. | Oct. | Vicinity of man, barns, chimneys. | *All* upper parts steel blue; forehead chestnut. | Well known. |
| Wryneck . . . | April. | Sept. | Woody districts; orchards. | Brown back; "moth-like" mottlings. | Loud reiterated cry in April and May. |
| Cuckoo . . . . | April. | Aug. | Universally distributed. | Barred breast, long tail. | Note; incubation; hawk-like flight, aggressive small birds. |
| Turtle Dove . . | May. | Sept. | Tall hedges, outlying plantations near arable land. | White and black neck rings. | Monotonous crooning note; nuptial flight. |
| Hoopoe . . . | April. | ... | Local bird-stuffer's establishment. | Large erectile crest. | Might breed; confiding; shot. |

# NOTES OF LESSONS ON HOW PLANTS FEED.

*Class.*—Suitable for Standard VII. in either urban or country schools.

*Time.*—Two lessons of thirty minutes each.

*Object.*—The chief object of these lessons is to instil a love of Nature in the minds of the children by exciting their interest in natural objects, but they will be found helpful in a course of systematic Botany.

**Step I. Preparation.**—In order to grasp this subject thoroughly the children should have received some instruction in the nature and properties of carbon, oxygen, and nitrogen; they should know that air is a mixture of these last two gases, and that it contains a small quantity of carbonic acid gas, which is formed by the union of carbon and oxygen. Experiments should be made in water culture. Having placed a few peas or beans in damp sawdust until they begin to germinate, wash them in clean water and fix them in position by means of corks in wide-mouthed bottles. A normal solution for water culture can be made as follows:—

| | |
|---|---|
| Distilled Water . . . | 1 gall. |
| Potassium Nitrate . . . | 1 dram. |
| Calcium Sulphate . . . | ½ „ |
| Calcium Phosphate . . . | ½ „ |
| Magnesium Sulphate . . . | ½ „ |
| Sodium Chloride . . . | ½ „ |
| Chloride of Iron . . . | A trace. |

This is a standard solution supplying all that is necessary for the growth of the plant. That each of these is necessary to the growing plant is proved by growing peas in different solutions, each corresponding to the normal solution, but with each of the salts omitted in turn; the effect of growing in pure water should also be tried. These specimens should be kept in the class-room so that the children may watch their growth. A day or two before the lesson a plant should be shut up in a dark cupboard in order that its leaves may be experimented on during the lesson.

**Step II. Presentation.**—All children know that an animal has to take food of some kind, and those that keep pets dearly love to feed them; but plants also take nourishment in a less obtrusive, but none the less interesting, manner.

*On what does a Plant Feed?*—In order to answer this question let us find what substances go to build up the plant. Take a turnip or a potato, and, after weighing it, dry it slowly in an oven; this will reduce the weight very considerably, showing that the greater part of the turnip consists of water. Continue heating, but at a higher temperature, and the turnip will soon be reduced to a black lump like a cinder, but this cinder, as we have already learned, is a form of carbon, so we see that next to water carbon is the substance that enters most largely into the composition of a plant. Now wrap a wire round the charred remains and hold them in a Bunsen flame; soon there is nothing left of our turnip but a little white ash, which represents the mineral matter which is present in the plant.

We have found that the plant is built up of water, carbon, and a little mineral matter, and therefore it must feed on these substances, but how does it obtain them. Let us examine the specimens that we have been cultivating in water. Those that are supplied with the normal solution are in a flourishing condition, showing that they have got all the nourishment that is necessary for their proper growth. The water and mineral matter are contained in the bottle, so the plant evidently absorbs these by means of the tiny rootlets that spread out in the solution. Those specimens that are living in solutions that are deficient of any of the necessary salts are not doing well, the one that has no iron is wanting in colour, and the others are stunted and weak. The plant, then, obtains its water and mineral matter by means of its roots, but it must obtain its carbon in some other way, for the normal solution contained no carbon at all. The air, however, contains a small quantity of carbonic acid gas, and it is the function of the leaves to break this up into the carbon and oxygen of which it is composed, retaining the carbon for the use of the plant, and setting free the oxygen.

*How the Root Feeds the Plant.*—We have seen that the root supplies the plant with the water and mineral matter that it requires. Now let us see how this is effected. All the nourishment that the root obtains from the ground must be in a liquid form; in fact, it is contained in solution in the water that it absorbs, but the point arises, how does this liquid run *up* the tree in order to feed the shoots at the top, the usual order of things being for water to run down. If we take a very fine tube and fasten it in a vertical position, with one end dipping into some coloured water, we shall find that the water is drawn some distance up the tube, and if we take several tubes we shall find that the water stands highest in the narrowest tube. Water will rise in a lump of sugar in the same way, for the spaces between the particles of sugar act like very fine tubes. The oil creeps up the wick of a lamp for the same reason; this may be shown by hanging a piece of wet lamp-wick over the edge of a beaker of water and letting the end dip into a pot of red ink; the ink will gradually creep up the wick until it reaches the beaker and colours the water. These examples serve to illustrate the way in which the sap rises from the roots to the highest point of the tree.

*How the Leaves Feed the Plant.*—We have seen that the leaves supply the plant with carbon by breaking up the carbonic acid gas which is found in the air, but we want to know what there is in the leaves to bring about this decomposition, and next how the carbon, which is a solid, is conveyed through the pores of the plant in order to supply nourishment to every part that requires it. If we soak leaves in water they do not colour the water at all, but if we boil them for a few minutes, then soak them in methylated spirit, they will lose their colour, and the spirit becomes green. Evidently, then, the well-known green colour of the leaves is due to some substance which is insoluble in water but soluble in methylated spirit. This substance is called chlorophyll. If a few sprigs of water-cress are placed under water and the whole exposed to the sunlight, the action of the chlorophyll will be shown by the bubbles given off from the leaves. These bubbles will not be given off unless the leaves are exposed to the sunlight, for, as will be clearly shown presently, the chlorophyll will only act upon carbonic acid gas in the presence of light. The duty of the leaf, however, is only half done when it has obtained a supply of carbon, for solid carbon is perfectly useless as a food for the plant. This fact is well known to dwellers in towns, where the leaves of plants are apt to get covered with soot, which is a form of carbon, but these particles of carbon, instead of feed-

ing the plant only choke up the pores of the leaves. Before the carbon can be of any use it must be changed into something that the plant can absorb into its system, viz., starch and sugar.

The properties of sugar are familiar to every child, and starch is known as a white substance that is used for stiffening linen. If we make some thin starch paste and add a few drops of solution of iodine, the starch paste will turn a deep blue colour; this is the best test for ascertaining whether starch is present or not. Pour a few drops of solution of iodine into some flour paste, also pour some on a piece of bread and on a slice of potato; in each case we get the blue colour indicating the presence of starch. Let us bleach a leaf by boiling it and soaking it in methylated spirits until it has lost its green colour; if we now dip it into a solution of iodine it will turn blue, indicating the presence of starch. This is a store of food stuff that the leaf has formed from the carbon, and which is laid up to carry the plant over the sunless periods when the leaves cannot obtain carbon.

Now test a leaf from the plant that has been shut up in the dark cupboard. We shall find that it does not contain starch, for the plant has drawn on its stock of food without the leaf being able to replenish it. We have not quite come to the end of the matter yet, for although the starch has gone from the leaf, the point as to how it went still remains to be settled, for, as we shall see, starch is quite as insoluble as carbon in cold water. This is shown by shaking up some starch powder in a little water and then filtering it to remove the starch that has not been dissolved; on testing the clear liquid that runs through, we find no trace of starch, showing that starch is insoluble in cold water. Before the starch can be removed from the leaf, therefore, another change must take place; the starch is changed into sugar, which is, of course, soluble and easily carried away.

What a wonderful little factory a simple leaf is, for here, as we have seen, carbonic acid gas is first of all decomposed, the carbon being converted into starch and stored up, then, as it is required, this store of starch is again changed into sugar and carried away. We might ask why the carbon is first changed into starch instead of being changed straight away to sugar. A moment's thought will show the beauty of this arrangement, for, if the leaves kept their store of food in the form of sugar, they would lose it during every shower of rain, hence these wonderful changes.

**Step III. Association.**—Several points would be taken up during the lesson and associated with kindred ideas. Thus plants would be compared with animals in respect to the nature of their food and their method of feeding.

Attention would be drawn also to the wonderful balance that nature preserves, for by breathing into lime-water, we can show that animals breathe out carbonic acid gas, which would in course of time render the air quite unfit to support animal life unless some means were taken to remove it from the air This, we have seen, is done by the plants, and thus the balance is preserved.

**Step IV. Formulation.**—1. Plants are built up chiefly of water, carbon, and a little mineral matter.

2. The water and mineral matter are obtained by the roots from the earth.

3. The leaves supply the carbon; the chlorophyll in the leaves in sunlight decomposes carbonic acid gas and retains the carbon.

4. This carbon is converted into starch and stored up in the leaves.

5. The starch is changed to sugar when the plant requires nourishment.

**Step V. Application.**—In an agricultural district the application of these lessons would be most important. Two points to be dealt with would be the use of manures, both natural and artificial, in supplying the necessary plant food, and also the fact that as plants do not all require these various food stuffs in the same proportion, it is necessary to vary the crops in order to obtain the greatest return from the soil.

## OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

### BURROWING UNDER THE ALPS.

#### The Simplon Tunnel.

RAILWAYS have brought about a beneficial revolution and imparted vital energy into human affairs, increased the volume of trade, and in a thousand ways have contributed more to happiness than any other discovery or invention. That this is fully recognised is proved by the almost superhuman efforts that in all parts of the world have been made to overcome physical obstacles; and in this respect no more striking examples can be found than the Alpine railways.

Shutting off Italy from the continent of Europe is the stupendous arc of the Alps sweeping round from the Riviera to the head of the Gulf of Venice. Range upon range—the Maritime, Cottian, Graian, Pennine, Lepontine, and the Carnic Alps—seem to present an almost impassable barrier to the traveller desirous of leaving the northern plain of Italy

Even the highest ranges were traversed by bridle roads in ages long past, such as that across Mont Cenis by which Pepin and Charlemagne entered the Italian peninsula. Nature, however, even in favourable seasons of the year, imposed a fearful toll upon the wayfarers whose temerity led them to make journeys in these altitudes. Napoleon to facilitate the progress of his armies converted these rude paths into carriage roads, which exist to this day, practicable and fairly safe at all times of the year. But the demands of international commerce necessitated freer communications, and now there are no less than seven railway routes to Italy:—

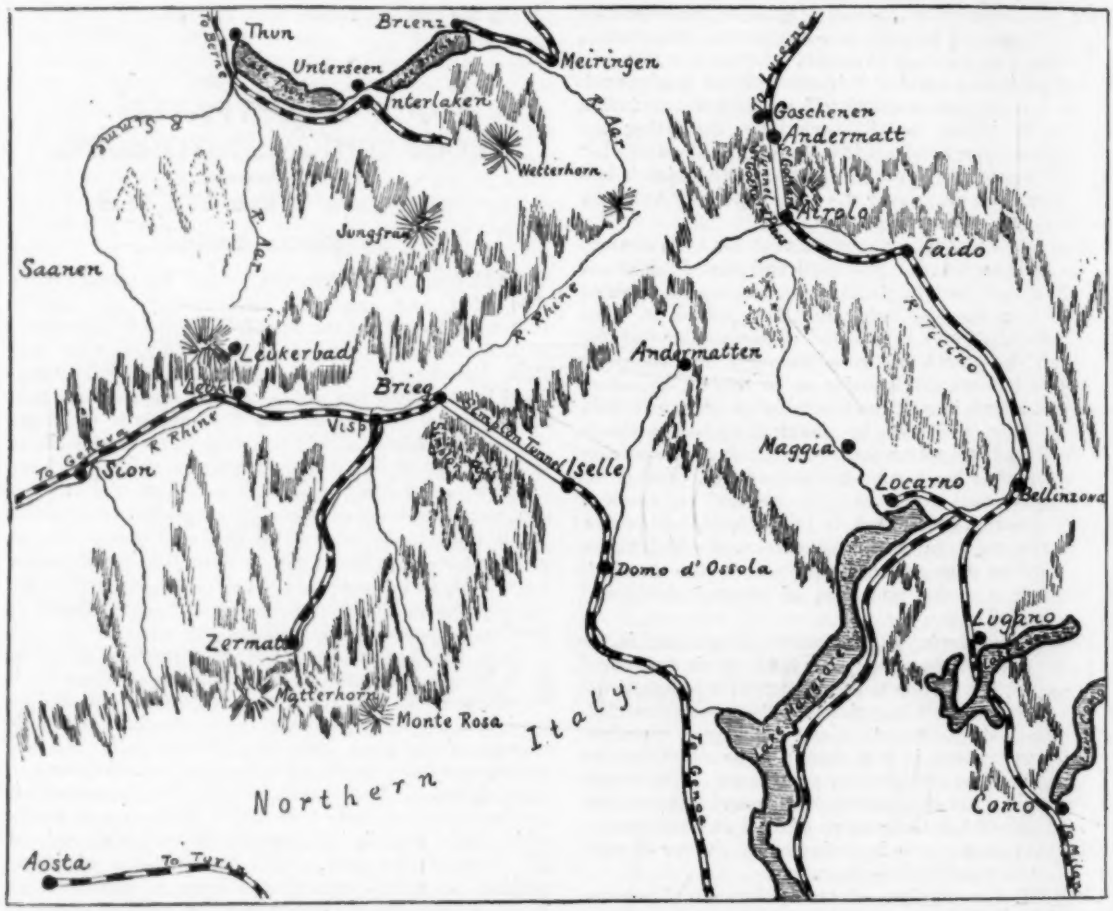
1. Riviera railway from Nice to Genoa.
2. Paris to Turin *via* Mont Cenis.
3. Brieg to Domo d'Ossola *via* Simplon.
4. Lucerne to Lugano *via* St. Gothard.
5. Coire to Colico over the Rhetian Alps.
6. Innsbruck to Verona *via* Brenner Pass.
7. Vienna to Venice *via* Pontebba over the Carnic Alps.

A railway under the Simplon Pass was discussed nearly half a century ago, but the scheme was abandoned in favour of one between France and Italy.

#### Mont Cenis Tunnel.

This tunnel was commenced in 1857. Progress was at first slow, not faster than 500 yards per annum, for the holes in which the blasting charges were placed had to be bored and dug out by hand. At that rate

the work would have occupied thirty years. Then came the invention of rock-drills worked by compressed air and water power, and the tunnel was completed in thirteen years. Its total length is 7½ miles; the cost of construction was £3,000,000, or £220 per yard; the width of the tunnel is 26 feet, height 20 feet, and it carries a double line of rails. The completion of the work marked a new era in railway development, and proved that even piercing the Alps with iron roads was but a question of money. This remarkable engineering




achievement provided unbroken railway communication for the Anglo-Indian mail from Calais to Brindisi *via* Paris, Dijon, Mont Cenis, Turin, Parma, and Bologna. The success of the new line was assured from the first, and soon Germany proposed a competitive scheme by means of which she would have access to Italy *via* the Swiss lines. A year after the completion of the Mont Cenis undertaking another great work was commenced to pierce the St. Gothard range.

### St. Gothard Tunnel.

St. Gothard is an Alpine mountain knot nearly 10,000 feet high. The famous pass (6936 feet) was improved into an 18-feet carriage-way in 1820–24. At the summit are two hotels and a famous hospice for poor wayfarers, over 10,000 of whom traversed the pass every year. The St. Gothard tunnel was commenced in 1872. The railway on the Swiss side climbs up the lower slopes until it reaches Goschenen at a height of 3639 feet, and after burrowing in the heart of the mountain for 9½ miles enters Italy at Airolo (3750 feet). Not only is this tunnel 2 miles longer than that of Mont Cenis, but the approaches include tunnels, galleries, and rock cuttings quite 20 miles in length, the whole work forming one of the most gigantic engineering undertakings of modern times. The work of construction occupied nine years, or, notwithstanding its greater length, four years less than the Mont Cenis; the total cost was £2,270,000, or £145 per yard. Some idea of the difficulties to be overcome may be estimated from the fact that six hundred lives were sacrificed during the operations. The mortality was largely due to the changes of temperature experienced by the men when they came out of the workings into the outer air. The chief engineer and the contractor lost their lives. The St. Gothard line shortened the route to Brindisi, and the new line promptly diverted £1,600,000 worth of traffic per annum from the Mont Cenis route. France did not view the depreciation with pleasurable feelings, and forthwith some of her political objections to the proposed Simplon tunnel were modified so as to gain a corresponding advantage over the competitor.

### Arlberg Tunnel.

France and Austria desired through connections without traversing Italy, and the Austrian Government constructed the Arlberg tunnel at a cost of £1,400,000, or £100 per yard. Improved methods of construction not only decreased the cost, but allowed the work to be completed in less than four years. Arlberg is a crystalline mountain mass between the valleys of the Rhone and the Inn, and separating the Vorarlberg and the Tyrol in Austria. There is a difficult pass over a ridge at a height of 5300 feet. The tunnel is $6\frac{1}{3}$ miles long; it was commenced five months after the completion of the St. Gothard line, and was opened to traffic in 1884.

### The Simplon Tunnel.

Brieg and Domo d'Ossola were long the adjacent outposts of the Swiss and Italian railways, and the Simplon Pass necessitated an eight hours' journey by diligence. The construction of the Simplon tunnel from the outset presented difficulties that seemed well-nigh insuperable. Its great length (12·2 miles, or 3 miles longer than any tunnel ever constructed), the varying treacherous strata, and the existence of hot and cold springs of great volume gave the engineers much cause for anxious consideration. Above the excavations was 7000 feet of mountain mass, which geologists affirmed would mean working in a rock temperature of from 104° to 107° F. In the case of the St. Gothard the temperature was 86° F., and this alone greatly interfered with the work.

AN INTERNATIONAL COMMISSION

of tunnel experts was called together by the Swiss Government. Italy, Austria, and Great Britain each nominated an engineer to examine and report upon the plans, estimates, &c. These gentlemen met at Berne in the early part of 1894, and after visiting the site of the proposed works drew up their report. In July of the same year the Governments of Switzerland and Italy entered into a treaty authorising the construction of the tunnel. The contractors, Messrs. Brant, Brandau and Co., of Hamburg, undertook to complete a single-track tunnel in less than six years at a cost of £2,800,000.

THE WORK COMMENCED.

In August 1898 the work was begun at Brieg, and at Iselle a few months later. Progress at first was tardy, for all the machinery was of special type, and much time was occupied in preparation. Mr. Brant had gained valuable experience in the construction of the St. Gothard tunnel, and now introduced a hydraulic drill or perforator which attained a speed hitherto unknown in rock tunnelling. Each drill cut four holes, one above the other, in which were exploded charges of dynamite. Liquid air cartridges were used for some time, but owing to numerous accidents were discarded, notwithstanding that Mr. Brant considered liquid air the blasting power of the future. For months 18 feet of gallery per day of twenty-four hours was excavated. The drills produced no dust, for the exhaust water of the machinery at once converted it into mud, thus aiding the comfort and health of the workmen. After the blasting operations the débris was washed away by powerful jets of water. Three thousand men were employed, and excellent arrangements were made for their comfort. They lived in large buildings near the entrances to the workings; good food was provided, together with baths and arrangements for drying clothes; and so far as possible every precaution was taken to protect the workers from sudden changes of temperature. The tunnel really consists of

TWO SINGLE-TRACK PARALLEL TUNNELS

about 52 feet apart from centre to centre, and connected with each other at intervals of 220 yards. Only one of the tracks has been arched; the other was chiefly for ventilation purposes and the conveyance of materials used in working, although when the traffic necessitates it will be completed as a second tunnel. Foul air has practically been unknown, and the workmen, kept in good health, combined with remarkable enthusiasm and discipline, contributed largely to the rapid rate of progress. The working day was divided into three shifts of eight hours each, and as one shift ceased work, another instantly took its place. The boring was carried on under the most miserable conditions, for

HOT AND COLD SPRINGS

were encountered, and the men worked in waterproofs under cascades of water. From each end of the tunnel the gradient gradually ascends towards the middle of the mountain mass, which facilitated drainage by gravitation. When 4796 yards from the Iselle entrance the drills struck a spring of cold water; the volume was over 12,000 gallons per minute, and the work was delayed for months. The strata in places was exceedingly treacherous, necessitating heavy timbering. The timbers, no matter how stout, were crushed, and steel girders had to be used in their stead, and even these were twisted out of all usefulness unless bedded in concrete. But the drills were kept at work, and the gallery gained in length. From the Brieg end the top of the gradient was reached, the men working in a temperature of 132° F., far higher than had been anticipated. To save time and to make up for that lost at the Italian end it was decided to drive down towards the gallery ascending from Iselle. Further troubles were soon experienced in the shape of hot springs of 117° F. The temperature was modified by the introduction of jets of cold water, but eventually the downward workings were flooded by the hot water, and work at the Brieg end ceased in May last.

At the Italian end the work was pushed on until another spring of hot water, 114° F., again impeded progress. The drills, however, soon passed the obstruction, leaving 12,000 gallons of hot water per minute to race down the gallery. At 7.20 on the morning of February 24th

THE TWO BORINGS MET

to almost a hand's-breadth, the last few yards being accomplished by means of pickaxes. The workmen, under great excitement, laboured in silence, while the eyes of the engineers were anxiously fixed on the black wall beyond which was the "pocket" of hot water that had stopped operations at the Brieg end. At length the perforation was accomplished, and the accumulated hot water swirled down the gallery. Man, after a Titanic struggle of seven years, had conquered Nature, had overcome the majestic mountains whose white peaks glittered in the morning sunlight. The miners danced with joy, and at the Swiss and Italian ends of the tunnel bands paraded the streets and cannon boomed to announce the completion of the arduous undertaking. The work of clearing the tunnel of

débris is proceeding apace; the masonry arching is being completed, and a water channel under the permanent way is under construction. The first train will probably traverse the tunnel early in May. For many a long year the Simplon tunnel will provide the world's most notable example of what may be achieved by the dogged determination and patience of the railway engineer.

The following is a table of the

PROGRESS OF THE BORINGS.

| | Yards. | | Yards. |
|---|---|---|---|
| 1898 . . | 524·2 | 1902 . . | 3885·8 |
| 1899 . . | 3768·1 | 1903 . . | 3889·1 |
| 1900 . . | 3707·0 | 1904 . . | 1812·6 |
| 1901 . . | 3810·6 | 1905 . . | 187·4 |
| | | | Miles. |
| | | Total . . | 21,602·8 = 12·2 |

Eighty-three lives were lost during the long operations, a remarkable immunity compared with the casualty list of the St. Gothard construction. Twenty-four hours after the completion of the boring the tunnel claimed two more victims. A party of engineers travelled in a special train to view the completed boring. Owing to the temporary failure of the ventilating apparatus poisonous gases had accumulated, and two of the party lost their lives.

By means of the new tunnel London is brought seventy miles nearer Milan. The stations at Brieg and Domo d'Ossola are particularly imposing, the one at the latter town being the largest in Europe.

Another Alpine tunnel is under contemplation, and before many years have elapsed the vitals of the Splügen will be pierced by yet another iron road.

## SOME BOOK NOTES.

BLACKIE AND SON.

**Macaulay's England in 1685.** Notcutt. It is a bold idea to place a chapter of Macaulay's History in the hands of schoolboys, and clearly shows the tremendous strides that have been made in recent times in the teaching of this subject. The selection of the third chapter of the History is a particularly happy one, for the vivid picture drawn by the master hand of our country, and the manners and customs of the people in 1685, cannot fail to hold the attention of the children and to give them an intelligent interest in this important subject. The book is carefully edited and annotated, all allusions, both classical and historical, being fully and accurately explained.

GEORGE BELL AND SONS.

**York Reader, Book I.** Although somewhat difficult this is an admirable reader. The subject-matter is varied and entertaining, the type clear, and the illustrations attractive. The suggestions for composition exercises on the chief lessons in the book are very praiseworthy.

W. AND R. CHAMBERS.

**Children of the Empire.** J. Finnemore. This is an excellent supplementary reader, in which life in our colonies is brought vividly before the children by means of a series of stirring tales dealing with episodes in the lives of young colonists. The illustrations are excellent, and will help the children to form correct impressions of the scenes in which the stories are laid.

W. B. CLIVE.

**Lucian: Charon.** Edited by T. R. Mills, M.A. This is a very simple Greek author, eminently suitable for a beginner's first reading instead of the usual Xenophon. The introduction is good and to the point; the notes give that help in matters of grammar and translation which beginners want.

CURWEN AND SON.

**Pippa's Holiday.** W. A. Bone. This dainty little volume will prove a friend indeed to the teacher of kindergarten at her wits' end for something new with which to inspire the mites. The stories cannot fail to interest the little ones, and to turn their minds in a right direction by thus leading them towards Browning, Longfellow, and Stevenson, from whom the stories are borrowed.

MACMILLAN AND COMPANY, LIMITED.

**Dux Christus: An Outline Study of Japan.** By William Elliot Griffis. Almost any book dealing with Japan, the new world power, is of particular interest at the present time. Especially is this the case in the present instance, for the author was the first foreigner called out to Japan under the "charter oath" of the Mikado in 1868 to assist in "relaying the foundations of the empire"; and Mr. Griffis is the only white man living who, in the castle city of a baron, saw the inner workings of the Japanese feudal system. The making of the nation is interestedly outlined through the medium of the work of Christian missions, and shows how Japan is likely in the twentieth to accept at the hands of Britain and the United States what she refused in the sixteenth century by way of Spain and Portugal. Japan, viewed from so uncommon a standpoint, presents features that cannot fail to enlist the interest and sympathy of Western peoples.

JOHN MARSHALL AND CO.

**Historical Geography of America, 1603–1688.** By Percy W. Ryde. In all cases history and geography should go hand in hand, but in no case is this more important than in the study of the development of the American Colonies. Although the title would seem to cover South America as well as North, this little book is full of information on the subject it deals with, the arrangement is clear, and there is a useful chronological table at the end. Certificate students will find this a most useful companion to the 1906 examination.

MEIKLEJOHN AND HOLDEN.

**Test Questions in Geography selected from Public Examination Papers.** By Arthur T. Flux. Over 800 questions arranged under countries and continents. The student who works carefully through the tests will be well equipped in the subject.

NOVELLO AND CO.

The parcel of music just to hand fully maintains the high reputation of this house. The series of School Songs has now reached the 162nd number, and still continues to supply teachers with high-class music that is suitable to children. Nos. 159 and 160 are particularly good. As so many schools now have violin classes, an *ad lib.* accompaniment for two violins has been added to most of the songs.

In "The Yarn of the *Nancy Bell*" (Burton) the composer has caught the humour of the words admirably, and we would commend it to those in search of a bright and telling cantata.

OLIVER AND BOYD.

**Elementary Practical Mathematics.** This little book, which includes the elementary portions of Arithmetic, Mensuration, Algebra, and Graphs, together with a short account of builders' estimates, is said to be specially designed to meet the requirements of technical students, and it will doubtless be of assistance to such, especially to those who have already some acquaintance with the subjects referred to. The arrangement adopted for the various sections leaves much to be desired. Thus on page 43 dimensions are given in chains and links to find the area in acres, but the connection between chains, links, and acres is not stated; all this and much more of the same kind is introduced before decimal fractions are dealt with.

**Mathematical and Physical Tables.** Prepared by John B. Clark, M.A. These form an admirable set of tables, including logarithms, antilogarithms, natural and logarithmic sines, cosines and tangents. The physical tables are well arranged and contain useful data on the properties of solids, liquids, and gases, heat, light, sound, magnetism, and electricity.

SIR ISAAC PITMAN AND SONS.

**Pitman's Lessons in English, Book IV.** This is a well-conceived series of exercises designed to meet the present requirements of the Code. The exercises are varied, and touch on most of the difficulties of the subject, and by the time the children reach the end of the book they should be able to express their ideas in clear and correct language.

# The Practical Infant-School Teacher.

## SUGGESTIONS FOR CARRYING OUT THE OCCUPATIONS IN CONNECTION WITH THE CORRELATED SCHEME OF WORK FOR AN INFANTS' SCHOOL.

### April, Week I.

*Clay Modelling.*—To model an egg well requires some care. If possible, have the model made the natural size, and model *direct* from the object. As a precaution, you are recommended to have the egg with

WEEK I.—CLAY MODELLING: HEN EGG.

WEEK I.—BRUSH PAINTING: CHICKEN.

which you demonstrate hard boiled before the lesson, in case of an accident. Show the egg, and ask the children what form they would obtain it from. Let them very carefully make the sphere; then show the egg again, and let them say what difference there is between it and the ball. With both hands gently roll one side: a very little pressure will be sufficient. When slightly rolled, examine it, and compare with the model—see that the surface is smooth and even. Children are much inclined to dig their fingers into the clay. This is a bad habit, and spoils the contour of any object; discourage it, and show in what way it depreciates the appearance, and especially in such an object as the one before us, where smoothness is one of the essential points.

*Brush Painting.*—This will be an exercise in real brush drawing. Yellow and some touches of brown will be the best colours. The teacher should show a finished painting; and then take it line by line, using a dark colour for the outline, even if the children use yellow, as then all will be able to see. Roughen slightly on the outline. Children of six who have had some practice in drawing will manage this well.

WEEK I.—CRAYON WORK: HEN AND CHICKENS.

*Crayon Work.*—This makes a very suggestive and interesting exercise. If possible, use three colours—green for the grass, brown for the hen, and yellow for the chicks. Reproduce by means of a copier, and give a copy to each child to fill in. Draw it on the black-

WEEK I.—PAPER CUTTING: HEN.

WEEK I.—BLACKBOARD DRAWING: CHICKEN.

WEEK I.—STICK LAYING: FOWL-HOUSE.

board, and demonstrate from that. This caution cannot be repeated too often. Some teachers seem to think that success in an exercise of this sort can be obtained without a demonstration on their part. This is the greatest mistake. Make your part as perfect as you can, and if you interest the children, you will have success.

WEEK II.—CLAY MODELLING: WATER DISH.

WEEK II.—BRUSH PAINTING: POND WITH REEDS.

*Paper Cutting.*—This is intended to be drawn first and then cut out. A very good plan is to give the children a piece of paper sufficiently large to draw the hen twice. Let them cut out the better drawing.

WEEK II.—PAPER CUTTING: DUCK.

*Blackboard Drawing.*—It would be well if the drawing lesson in this case preceded the painting, as the children would acquire a certain power and knowledge by *drawing* this first with the pencil and then with the brush. Be careful to point out that all the lines required here are different varieties of curves, except indeed for the legs.

WEEK II.—BLACKBOARD DRAWING: DUCK.

*Stick Laying.*—Three sizes of sticks are required for this. Explain what is going to be done, and show that it is the front of the fowl-house that will be represented. Have the sticks sorted into lengths. Take up two of the longest sticks to represent the roof. Let the children hold the sticks, slanting one against the other, and then put them on the desk in the same position as indicated in the illustration. The roof, sides, and doorway of this can be laid in two's. The picture might be laid on a slate, then the teacher can reward the diligent by drawing a chicken at the side of the fowl-house.

WEEK II.—CRAYON WORK: DUCKS ON POND.

WEEK II.—STICK LAYING: FOWL-HOUSE (from memory.)

## April, Week II.

*Clay Modelling.*—This object is very much the shape of a saucer, only that the sides are straight, not curved, sloping slightly outwards. Model it from the sphere on the same plan as the trough given for March, Week IV.

*Brush Painting.*—This should be regarded as an exercise in the direct use of the brush. You are strongly advised not to form the head of the bulrush with a simple blob, as it does not really represent it truly. Let the children *paint* it on a rather larger

WEEK III.—CLAY MODELLING: PRIMROSE LEAF.

WEEK III.—BRUSH PAINTING: PRIMROSES.

WEEK III.—CRAYON WORK: BASKET OF PRIMROSES.

scale than in the illustration; do not omit the slight point at the top. Use vandyke brown and green for stalks and leaves. Avoid the bulrushes all standing up perfectly straight in a row. Paint the leaves by simple brush strokes, beginning from below. A few somewhat wavy lines for the water will complete it.

WEEK III.—PAPER CUTTING: PRIMROSE LEAF.

WEEK III.—BLACKBOARD DRAWING: VASE.

*Crayon Work.*—This would be treated on the same plan as the illustration for the same work in Week I. Brown with a touch of blue on the breast for the duck. An outline of blue with a few wavy lines for the water, and yellow for the ducklings, will make an effective picture.

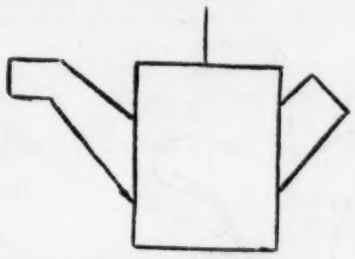
*Paper Cutting.*—This should be drawn first and then cut out. The bend in the back of the neck requires care, also the feet, but it ought to be successfully done by six-year-old children.

*Blackboard Drawing.*—If this lesson could precede the paper cutting it would be a help. The teacher will, of course, show a finished drawing of this first. Do not expect *perfect* work from young children. The fact that they put forth effort, and gain in self-reliance, is far more important to their characters than that they should show an unnaturally perfect piece of work. After all, it is character which will tell most in the long run.

*Stick Laying.*—The fowl-house from memory.

### April, Week III.

*Clay Modelling.*—A slab of clay is necessary for this. The children should make it quickly, as previously described. Give a primrose leaf to each child, or one between two, and let the children examine and describe it—crinkled, covered with veins, blunt at the top. Flatten a piece of clay in the hands, then with a pin or point of a slate pencil draw upon the surface the shape of the leaf. It may be cut round without the use of any tool but a fair-sized pin or pricker, and then placed upon the slab. Very carefully mark upon it the veins, and especially the thick mid-rib, and with the fingers work up the edge of the leaf so that the outside edge does not present an absolutely unbroken straight line.



WEEK III.—STICK LAYING: WATERING CAN.

*Brush Painting.*—Before the children attempt this, give some practice touches for the petals of the flower. Let the children use pale yellow, but paint with sepia yourself on the blackboard. You will require light green for the calyx and stems. The only difficulty seems to be in getting the correct spacing for the petals, five in number. Leave some white streaks in the petals; it will improve the appearance.

*Crayon Work.*—This needs some care. It should be enlarged, which would lessen any difficulty. The colours would be brown for the basket, and yellow for the primroses. It makes an exceedingly pretty picture.

*Paper Cutting.*—Have this drawn first, and then cut out. With a lead pencil mark the mid-rib and the veins. It may also be cut from a piece of paper folded in half; in this case the fold would be along the mid-rib.

WEEK IV.—CLAY MODELLING: BELL.

WEEK IV.—BRUSH PAINTING BLUEBELLS.

WEEK IV.—CRAYON WORK BLUEBELLS.

*Blackboard Drawing.*—Here is a good opportunity for giving practice in making opposite curves. Let the object be a fair size, so that the arm may have free play. The children should first practise the required curves before attempting to draw the vase as a whole.

*Stick Laying.*—Four sizes of sticks are required for this. It includes straight and oblique lines. The teacher should draw it first, then rub it out, and while she demonstrates in laying the sticks, draw each line again as she takes it.

**April, Week IV.**

*Clay Modelling.*—Take a lump of clay and divide it into three pieces—one large piece and two quite small pieces. Take the large piece and roll it into a ball, then from this obtain the cylinder. Hollow this out at one end by pressing your thumbs into it, in very much the same way as you would in making a nest, only that, of course, this object must be more elongated, with the widest part at the bottom. Have a bell to show the children, and point out the very pretty curve which it presents. Keep the exterior as smooth as possible. When the shape is nicely made, use the two small pieces of clay, one to make the handle, and the other the clapper inside. As the clay modelling lesson will probably be an expression lesson following on the nature lesson, you will, of course, connect the two by drawing the attention of the children to the fact that they are modelling the bell shape seen in the bluebell.

*Brush Painting.*—This is a very effective and interesting study. Obtain the colours by mixing cobalt blue and crimson lake, and use sap green for the leaves. Paint the stalks of the bluebells first green; they should not stand up perfectly straight, but paint from nature if possible. Let the children paint the flowers, *not* blob them, and leave some streaks of white; the bracts are blue as well as the flowers. The stalks should be done by means of brush strokes beginning from below.

*Crayon Work.*—Blue and green will be the colours required for this. In crayons the exact shade cannot be obtained as in painting—violet, if not very deep, might be preferable to *dark* blue.

*Paper Cutting.*—This is intended to be drawn first and then cut out; it is not difficult. Some lines might afterwards be added in lead pencil showing the markings on the basket.

*Blackboard Drawing.*—It would be advisable to enlarge the size of this. The teacher should demonstrate, and show the bluebell plant if possible.

*Stick Laying.*—Three sizes of sticks are required for this. The teacher will, of course, connect the lesson with the week's work in some way which she will know best.

WEEK IV.—PAPER CUTTING: BASKET.

WEEK IV.—BLACKBOARD DRAWING: BLUEBELL PLANT.

WEEK IV.—STICK LAYING: BELL.

## SCHOOL GARDENING FOR LITTLE CHILDREN.

BY LUCY R. LATTER.

### PART VII.

"Each thing upward tends, by necessity decreed,
And a world's support depends on the shooting of a seed."

I HAVE dealt in turn with a natural phenomenon, a spring flower, and an animal. In this article I shall show still further how our school gardening is related to the rest of the school curriculum by reproducing an example from the vegetable world.

The radish (*Raphanus sativus*) was the first vegetable of our own growing to come under our special consideration. It afforded material for thought and work part of one June and July and the following August and September.

**B. II.*—The Standpoint from which the Subject was considered with the Children.**

"And still with reverent hands we cull
Thy gifts each year renewed;
The good is always beautiful,
The beautiful is good."
—WHITTIER.

We chose the radish as a subject for special consideration during the time indicated above because we wished to lead the children to observe the wonderful way in which plants live and provide for their successors; how many complete their life's work much more quickly than others, and how throughout much of the lesser life on the plane of the plant world has to yield itself up for the sustenance and support of the life on a higher plane, that of the animals and even of man himself.

The seeds sown in the school garden the preceding March, and thenceforward so carefully watched and tended by the children, had by June formed "storehouses" of food for their own later use if left undisturbed. The "storehouses" of such plants as the radish, carrot, &c., form, however, food for human beings, and few of them, therefore, are left in the ground, even in a school garden, unless for special purposes.

The radish was the first vegetable produce yielded by our garden, and the ingathering of it was, therefore, marked by a little radish feast, which was shared by many of the children's parents and some friends. In "pulling" the radishes care was taken to leave some

* In the method of procedure (see Article IV., November 1904) A = Experience with the real thing; B. I. = Notes or information for the teacher.

of them in the ground that the children might see later on in the season what the plants do when left to complete their work, and what use they then may be to mankind as well as to their own species. If left undisturbed the plant lives upon the store it has laid up, and raises its stem and flowers and seeds out of that abundance, and, having fulfilled its destiny and provided for its successor, yields up its residue to

*"Soft visions of serene delight."*

Mother Earth for the renewal of the soil. The seed-boxes form another article of food if gathered in the green state and pickled.

Thus all the way through there is a giving and taking between man and nature, and over all is the Great Planner and Providence, ever ready to give of His great bounty to those who will lovingly watch and tend the lesser receptacles of His wonderful Power.

"The child, the seed, the grain of corn,
The acorn on the hill,
Each for some separate end is born
In season fit, and still
Each must in strength arise to work the Almighty Will."

### B. III.—Plan of Work with the Children.

Sowing time recalled. The names of some of the seeds sown by the children in the vegetable garden. *The actual date when the radish seeds were sown. What they looked like. The beds in which they were sown. How they were sown—(first mixed with some finely sifted earth, then scattered over the beds, these then lightly covered with the remainder of the sifted earth). The first appearance of the tiny plants above the ground; their further growth. The thinning out of the radish beds, and why it had to be done.

*The first class children refer to their calendars for dates, &c., marking any special facts in the life and growth of the radishes in the school garden. Visit to the radish beds in the garden. The familiar part of the plant known as the radish visible in many cases. What this tells us. "Pulling" of some of the radishes by the owners of the beds. Washing of the "pulled" radishes.*

#### The Radish.

What part of the plant is the radish? The pretty colour, the shape and size of the radishes from the school garden. Why we like radishes. As they are the first vegetables from our little garden it would be nice to mark the ingathering of them by a little radish feast to-morrow afternoon. Perhaps some of the children's parents and a few other friends would like to come and share the pleasure.

*A radish (on a plate belonging to the babies' tea or dinner service) is provided for every two children to examine. At the end of the lesson the radishes are gathered up and put in a basin of cold water until they are needed again. The little plates are also collected, wiped, and put away.*

*Sending of a verbal invitation to some of the parents to the proposed "feast" through the children, and of the following note to a few other friends.*

The "Invicta" Board School,
Westcombe Park, S.E.
*Infants' Department.*

The owners of the radish beds in the garden of the above school beg to say that the radishes therein will be "pulled" to-morrow (Thursday) between 10 and 11 A.M.—weather permitting.

At 3.45 P.M. the children and staff of the school will assemble in the hall to partake of the radishes gathered in the morning.

During the earlier part of the afternoon a group of children will prepare the radishes and set the table.

Friends who would like to share the pleasure will be cordially welcomed either morning or afternoon.

Lucy R. Latter,
*Headmistress.*

*June 11th*, 1902.

(*The foregoing is a copy of the actual letter sent to the friends.*)

#### The Feast.

Joy in "earth's increase, foison plenty."
Gratitude to the Giver of all good things.
The joy of sharing our gifts with others.

We are all glad that our little garden has yielded such nice produce, but unless the Great Giver of all good things had touched the tiny seeds we put in the ground a little while ago, we should never have been able to have a little radish "feast" to-day.

What pleasure we shall be able to give our visitors, for every one will like to taste the first radishes grown in our little school garden! We must prepare them very nicely, and then arrange them daintily in pretty dishes ready for the "feast."

*"Pulling" of all the radishes ready for eating, the remainder left to continue their work.*

*Preparation of the "pulled" radishes and setting of the tables, &c., in the hall by the owners of the radish beds and a few comrades.*

*Reception and assembly of all the "guests" in the hall for the dainty "feast" at 3.45 p.m.*

#### Further Consideration of the Radish.

The thick fleshy part, the little hairy "threads" growing from it. The work of both. The "threads"

* Points with an asterisk against them are only for the upper part of the school.

or fibres seize the earth like so many little fingers, and hold the plant firmly in place. They also get the food material from the ground, and then the thick fleshy part stores up a good deal of it for later use. When the children prepared the radishes for the "feast" they carefully took off the little fibres, and we only eat the thick part. The hot taste recalled. In what part of the radish does it seem strongest?

*Radishes brought to school and distributed among the children for examination as on previous occasion. Some radishes peeled—the thickness of the skin, and the colour of the radish when the skin has been removed, noticed; also the taste of the radish without the skin.*

The "crown" of the radish and the cluster of leaves springing therefrom.

The colour, size, and shape of these leaves. The slightly notched and crinkled edges of the early ones. The surface of the leaves—smooth or otherwise? The veining. Sometimes the young leaves of the radish are made into a salad and eaten.

*A radish with the leaves still at the top provided, as on other occasions, for every two children to examine. The leaves removed and made into a simple salad, which the children partake of at the end of the lesson. The remainder of the radish is also eaten.*

### The Radish Plant as seen Growing in the Garden in June and July.

The stem gradually developing. The leaves getting more toothed, the teeth getting wider and less pointed, and more in number.

*Visit to the radish beds in the garden. The height of some of the plants left there found out by individual children. Other changes on the plants noticed.*

*Fresh sowing of radish seeds for a later crop.*

## AUGUST AND SEPTEMBER WORK.

### The Radish Plant as seen Growing in the Garden in August and September.

Thanks to its rich store of food the plant has been able to grow very tall and send out many leaves and pretty flowers. General appearance of the plant.

*The height now of some of the plants left in the garden found out by individual children. The number of flower-buds—of flowers on a single plant counted.*

### The Flower-bud.

A number of little buds on a stem, each bud having a little stalk of its own. How the buds are arranged on the stem. Their shape, colour, and size. How the flowers are packed within.

*A few flower-buds gathered from the garden and taken into school to be examined, and then kept there in water to see what may happen.*†

† The children now keep small growing plants and gathered specimens in pots and little bottles on tins arranged on their own desks, as well as on the shelves and tables in the room.

### The Full-blown Flower.

The pretty colour of the radish flowers. Their size. The way they hold themselves. The outer leaves, their number and colour. What we find when we move our fingers gently round the bottom of our flower. * What these little swellings mean.

The inner flower leaves arranged in the form of a pretty cross. * The relative position of the outer flower leaves to the inner ones. Why the flower leaves are arranged so that there is no space left unprotected between them. There must be something very precious inside which needs to be guarded so carefully. What we notice when we look inside a radish flower. The "dust-spikes" (or stamens). Their number. There is something very curious about these "dust-spikes." Two seem shorter than the others. Can the children think why this is?

The slender column (or pistil) in the middle of the flower; its sticky head.

*Some full-blown flowers gathered from the garden and taken into school for examination. At the end of the lesson these are collected and carefully arranged in a glass of fresh water. Any insect "visitors" to the plants noticed by the children when in the garden.*

### The More Matured Foliage.

The leaves of the radish plant are much coarser and more hairy than when we looked at them a little while ago. They are also now almost divided into leaflets at the bottom. Each portion, however, is still connected by a narrow strip of the leaf. The way the leaves grow on the stem. The stem much more developed and getting woody in character.

*Some leaves gathered from the garden by individual children and taken into school for examination. Other children tie up the straggling radish plants. In doing this they find that the stems and leaves sting their hands almost like a nettle. The cause of this found out.*

*The foliage taken into school is put into a glass of fresh water at the end of the lesson.*

### The Fruit of the Radish.

Many of the pretty flowers left on our radish plants have disappeared, and in their place a curious green thing has come. Its shape and size. A thick part which "bulges" out a great deal, and a long tapering end. The name given to this latter part (the "beak").

These curious green things are the treasure-boxes of the radish plant. By-and-by, when the plants open their treasure-boxes, we shall be able to see what is inside.

*A few pods gathered from the garden and taken into school for examination. The children find out the length of the pod as a whole, the length of the beak, &c.*

### Economic Value of the Fruit of the Radish.

When carefully prepared the young radish pods make a nice pickle. As we have so many pods in our garden we will see if we can pickle some of them.

*Preparation for and pickling of radish pods.*

*A number of green pods are gathered from the garden by individual children—the owners of the radish beds and a few comrades. The while two or more children go out with a teacher to buy given quantities of the things necessary for making the*

*pickle (salt, white or brown vinegar, mace, ginger, long pepper, and horse-radish). The pods are put into salt water for a night. Boiling and re-boiling of the salt and water, and pouring and re-pouring of the same over the pods till they are green. Final draining of pods and putting of them into the pickle prepared from the above ingredients. Tying down of glass jars, pasting on of labels prepared by the older children beforehand. Putting away of the jars of pickles in a dry place until required for eating.*

### The Ripened Fruit, or Seed born of the Radish.

The appearance now of the plant's treasure-box. What has happened to some of the "boxes." The curious way in which the plant opens its treasure-box (transversely, &c.). The number of divisions in the box. The "treasures," beautiful little dark brown seeds. The number in some of the boxes. The little covering which each little seed seems to have had.

*Ripened pods gathered from the garden and examined in school. The seeds carefully shaken out into little paper boxes made beforehand by the older children. Examination of the seeds and also of the empty pods.*

*Seeds placed in shallow boxes and left in the sun to dry. Paper bags made and labelled by the children. The dried seeds put into these bags, which are then fastened down and stored away until sowing time comes again.*

### The Spent Plant.

The general appearance now of the radish plant. The stem and root. The hollowness of the stem noticed. The change in the radish itself—it is no longer thick and fleshy, and therefore nice to eat. What has become of all the food which the plant stored up in it a little while ago?

What a wonderful life the plant has lived, and how beautifully everything has been arranged that every step might lead to something more beautiful and useful! How tenderly the plant prepared for and took care of its baby seeds until they were strong enough to wander into the world! The plant has still some work to do. It will go back to Mother Earth and help to make the soil rich for other little seeds.

*Pulling up of the radish plants which have done their work as such in the garden. The children then examine the stem and root. The plants are then removed to some suitable place, where they may help to form mould for future use.*

### Work in the Garden.

*June and July.*

Watering, weeding, tidying of beds (groundsel and chickweed saved for pet canaries).

Protecting of plants from natural pests:—watering the broad beans with soapy water to rid them of the black fly (aphis), and the beds with paraffin water to free the soil of destructive grubs; putting down of soot and salt around plants visited by slugs, lime for protection of plants from other animals such as ants.

Thinning out of the following and other beds as may be necessary: radish, lettuce, cabbage, carrot, mignonette, helichrysum, &c.

Staking of lilies, stringing of runner beans, staking of peas, pulling of radishes.

*August and September.*

Weeding of beds, tidying of beds and borders.

Gathering in of beans.

Nailing up of trailing ivy sprays, lilac, and jasmine.

Propping up of sunflowers, dahlias.

Clearing of the radish beds.

Ingathering of any seeds which are ripe in other beds, for example, flax, clarkia, larkspur, convolvulus, alyssum, eschscholtzia.

Staking the chrysanthemums.

Plants in various beds cleared of caterpillars likely to injure them. Caterpillars taken into school to be taken care of and watched there during the ensuing months.

*(List of Reference Books will be given next month.)*

## IV. The Gifts, Occupations, Games, Stories, Pictures, Recitations, and Hymns used in Connection.

| | Class I. | Class II. | Class III. | Class IV. | Class V. | Class VI. |
|---|---|---|---|---|---|---|
| Drawing (free and other). | Radishes of various kinds, bunch of radishes, garden basket, bowl, dish, knife, plate, salt-cellar, spoon, early leaves, full-grown leaves, head of flowers, flower vase, fruit on a stem, glass jar, saucepan, plan of the vegetable garden, position of the radish beds indicated thereon, front of store-cupboard. | Radishes of various kinds, bunch of radishes, watering-can, garden-basket, bowl, knife, dish, plate, salt-cellar, spoon, early leaves, full-grown leaves, head of flowers, flower-vase, fruit on a stem, glass jar, saucepan, front of store-cupboard, plan of the radish beds. | Radishes of various kinds, watering-can, garden-basket, bowl, knife, dish, plate, salt-cellar, spoon, a single early leaf, a single full-grown one, single flowers, shallow flower-bowl, single pods, glass jar, saucepan, front view of fireplace. | Radishes of various kinds, watering-can, garden-basket, bowl, knife, dish, plate, pods, glass jar, saucepan, front view of table. | Radishes of various kinds, garden-basket, bowl, knife, vase, pods, glass jar, saucepan. | Radishes of various kinds, garden-basket, bowl, knife, vase, pods, glass jar, saucepan. |
| Brushwork and Colouring. | Radishes of various kinds, leaves, flower-buds, flowers, fruit. | Radishes of various kinds, leaves, flowers, fruit. | Radishes of various kinds, a leaf, single pods. | Radishes of various kinds, a leaf, a pod. | | |
| Modelling. | Radishes on a dish, plate, flowers, leaves, vase, pods, saucepan, plan of the kitchen garden. | Radishes of various kinds, basket, dish, bowl, salt-cellar, leaf, vase, pods. | | | | |

## IV. The Gifts, Occupations, Games, Stories, Pictures, Recitations, and Hymns used—(*Continued.*)

| | Class I. | Class II. | Class III. | Class IV. | Class V. | Class VI. |
|---|---|---|---|---|---|---|
| Paper Folding. | Basket, dish, salt-cellar, double flower vase, table, chair, boxes for seeds, bags for storing of seeds, labels for glass jars (folding and cutting) (oblong and square-shaped paper). | Basket, salt-cellar, vase, flower, table-cloth, seats, boxes for seeds, bags for storing of seeds (square-shaped paper). | Table-cloth, basket, envelope and folded "note-paper," front of store-cupboard, vase, boxes for seeds (square-shaped paper). | | | |
| Gift IV. (Classes II. and III.)<br>Gift III. (Classes IV. and V.)<br>Tablets† (Squares). | | Garden, well, basket, table, table and seats, shop, cupboard, fireplace, plan of vegetable garden. | Garden, well, basket, table and seats, long seats, shop, cupboard, fireplace. | Garden wall, garden, pump, kitchen-table, tables and chairs, fireplace, cupboard, salt-cellars.<br>†Objects made with Gift III. reproduced on the flat. | Garden walls, garden, pump, kitchen-table, table and chairs, big seat, fireplace, cupboard. | |
| Rings and Sticks (Class III.)<br>Sticks or Laths (Classes IV., V., VI.) | | | Radishes, basket, bowl, knife, spoon, dish, plan of the flower, vase, saucepan, fireplace, glass-jar, watering-can. | Long radishes, basket, basin, front of table, saucepan, fireplace, front of store-cupboard, watering-can. | Garden fence, long radishes, basin, saucepan, fireplace, chair, table. | Garden fence, long radishes, basin, chair, table, saucepan, fireplace. |
| Jointed Lath (Class V.)<br>Fraying (Class VI.) | | | | | Garden fence, long radish, basin, saucepan, chair, table, basket, vase. | Mats to go under the dishes, and vases arranged for the feast; wind "dolls" for the garden to keep the birds from the young plants; little brooms for the sand garden. |
| Gift II. | | | | | Exercises with the cylinder (roller, etc., for the sand garden). Exercises with the cube (watering-can, etc., for the sand garden). | Exercises with the cylinder (roller, etc., for the sand garden). Exercises with the cube (watering-can, etc., for the sand garden). |
| Sandwork. | | | | | A kitchen garden (little green, red, and white beads added to some of the beds to indicate first the leaves appearing above the ground, then the white or red radishes). A flower garden (beds bordered with shells or beads, or with beads "threaded" on little sticks). | A kitchen garden (little green, red, and white beads added to some of the beds to indicate first the leaves appearing above the ground, then the white or red radishes). A flower garden (beds bordered with shells or beads, or with beads "threaded" on little sticks). |
| Thread Laying. | | | | | Radishes of various kinds, basket, bowl, knife, vase, pod, glass jar, saucepan. | Radishes of various kinds, basket, bowl, vase, glass jar, saucepan. |
| Bead Threading. | | | | | | Beads "threaded" on little sticks, etc., for fence and border for the sand gardens. |
| Games. | Summer Joy.<br>Shower and Flower.<br>Summer. | The Sunbeams (Now what shall I send to the Earth).<br>Summer Days.<br>The Song of the Bee. | 'Tis Raining.<br>Thanksgiving Song.<br>The Bees' Market. | Summer Song.<br>Straight and Tall in the Garden Bed.<br>Come, Little Leaves. | Rain Song.<br>The Sunshine's Song.<br>Happy Summer.<br>The Garden.<br>Taste Song.<br>Flower Song. | Pitter, Patter, here they come.<br>The Little Gardener (Come, Children, with me to the Garden).<br>The Wheelbarrow.<br>Taste Song.<br>Smelling Song.<br>The Flower-bed.<br>The Greeting. |
| Stories. | Inside the Garden Gate.<br>Treasure-Boxes. | A June Morning.<br>Clytie. | The Dewdrops and the Blossom.<br>Do what You can. | The Story of the Radish Seed. | The Sunbeams. | The Sunbeam Fairies. |
| Pictures. | Summer (Henri Rivière).<br>The Gleaners (Millet). | Happy Days (Fred Morgan).<br>Summer (Seasons: Fitzroy). | Pictures of the Months (Fitzroy). | The Working Man's Garden (W. & A. K. Johnston). | The Costermonger (W. & A. K. Johnston). | The Little Gardener (Froebel).<br>The Garden Gate (Froebel). |
| Recitations. | After the Rain.<br>The Gardener. | The Sunbeams.<br>September. | Sunshine.<br>All the World is filled with Sound. | Radishes.<br>Ding-Dong (Sing a Song of Summer). | | |
| Hymns. | Blessings on Effort.<br>Thanksgiving Song. | As in I. | As in I. | As in I. | As in I. | As in I. |

# Our Modern Language Section

## FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than April 8, 1905**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

**A Prize of Half a Guinea** is offered for the best rendering into English of the following extract:—

Il y aura sans doute encore des guerres. Les instincts féroces, unies aux convoitises naturelles, l'orgueil et la faim, qui ont troublé le monde durant tant de siècles, le troubleront encore. Les immenses masses humaines, qui tendent à se former, n'ont pas encore trouvé leur assiette et leur équilibre. La pénétration des peuples n'est pas encore assez méthodique pour assurer le bien-être commun par la liberté et la facilité des échanges, l'homme n'est pas encore devenu partout respectable à l'homme; toutes les parties de l'humanité ne sont pas près encore de s'associer harmonieusement pour former les cellules et les organes d'un même corps. Il ne sera pas donné, même aux plus jeunes d'entre nous, de voir se clore l'ère des armes. Mais ces temps meilleurs que nous ne connaîtrons pas, nous les pressentons. A prolonger dans l'avenir la courbe commencée nous pouvons apercevoir l'établissement de communications plus fréquentes et plus parfaites entre toutes les races et tous les peuples, un sentiment plus général et plus fort de la solidarité humaine, l'organisation méthodique du travail et l'établissement des États-Unis du monde. La paix universelle se réalisera un jour, non parce que les hommes deviendront meilleurs (il n'est pas permis de l'espérer), mais parce qu'un nouvel ordre de choses, une science nouvelle, de nouvelles nécessités économiques, leur imposeront l'état pacifique, comme autrefois les conditions mêmes de leur existence les plaçaient et les maintenaient dans l'état de guerre. ANATOLE FRANCE.

### RESULT OF THE MARCH COMPETITION.

The prize is awarded to "Robin." (Will "Robin" kindly forward name and address for publication?)

*First Class.* — Butterfly, Agaznog, Eicarg, C.E.M., Little Billy, Barberton, Jabberwock, Agenaise, Fittick, Trente-et-un, Ras, Gowanlea, Sweetbrier, Esther, En bon espoir, Dunkeld, Garnet, Adlitam, To-ki, Shakspere, Mosquito, Fitzthomas, Theodore Vincent, Cinq-Mars, Sorbonne, Le petit caporal, La Printanière, Madame de Maintenon, Balmer, Mr. Micawber, St. Regulus, Odd number, Deloraine, Philippe, Arsanca, D.J.E., Betty, Claughton, Glen Shee, M.E.T., Bracebridge, Furnessian, Maybug, Bea, Menai, Nomad, Nehemiah, Trilby D, Vive vale, F.A.G., Mouscron, D'Arcy, Awa Maru, Yorick, Caen, Kate, Margaret, Rosamund, Les gens à pied, Haye-du-puits, Yew, Grimbarian, Mannie, Personne, Woodbine, S.A.G., Lex, Elephante, Gabrielle, Fido, Twist, Gipsy, Oratava, Hockley, Guillaume, Shamrock, Aurora, La Sentinelle, Aim, Solkuk, Chaos, Fleur-de-lys.

*Second Class.*—Katze, Trots, Woolley, Lucrezia, Maxwell, Ernestine, La débutante, Seize, Lychris, Ruby, Jeannette, Petit, Raphael, Co-operator, Polly, Gladiola, N.P.T., Baz, Janet, Hardup, Phlox, Beauty, Commodore Nelson.

*Received too late.*—M.P.R., Baldur, Channa, Ten, Mimosa, Achab, Avina, Marguerite.

The name and address of the winner of last week's competition are:—Alex. W. Farquhar, 23 Ferryhill Place, Aberdeen.

#### Report.

It was not at all easy to make the award this month, as the merit of the first dozen or so papers was very high. There were but few difficulties in the piece set. *Difficile* in the sense of "hard to please" was a stumbling-block to many. The perversity of human nature probably accounts for the fact that when there are few real difficulties to encounter, people are most apt to create imaginary ones. Thus four or five students translated *toile cirée* as "cerecloth"; *une partie du Carême* became "a Lenten party"; *s'éclairait à la chandelle* was translated "got information by the candle," or "read in bed"; and *la bonne femme ne s'y refrotta plus* became "the good woman did no more than rub herself."

#### Prize Translation.

But it was chiefly at meal times, in that little room on the ground floor, with its smoky stove, creaking door, oozing walls and damp floor, that she felt completely exhausted; all the bitterness of life seemed to be served on her plate, and in the steam of the broth it rose from the depths of her soul in sickening gusts. Charles was slow in eating; she nibbled a few nuts, or, leaning on her elbow, amused herself by drawing lines on the tablecloth with the point of her knife. She completely neglected her household affairs; and when the elder Madame Bovary came to spend part of Lent at Tostes, she was extremely surprised at this change. She, in truth, formerly so careful and dainty, now passed whole days without arranging her toilet, wore grey cotton stockings, and used cheap candles for lights. Besides, Emma was no longer disposed to follow her advice. Once, indeed, Madame Bovary having taken up the notion that masters should look after the religion of their servants, she replied with such a scornful glance and chilling smile that the old lady dared not mention the subject again. Emma became wilful, capricious. She would order dishes for herself and leave them untouched; one day she would drink nothing but fresh milk, and the next cups of tea by the dozen. Often she obstinately refused to go out; then she was stifled, the windows were opened, and she arrayed herself in the lightest of robes. When she had ill-treated her servant, she made her presents, or sent her among the neighbours for a walk. In the same way she would sometimes throw all the silver in her purse to beggars, although she, like the majority of peasants born and bred, who still retain in the soul somewhat of the callosity of the paternal hands, had no sympathy whatever for them.

ROBIN.

# OUR TUTORIAL SECTION

## OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

*Late Principal of the Belvedere Pupil Teacher Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.*

### SCHOLARSHIP COURSE FOR DECEMBER 1905.

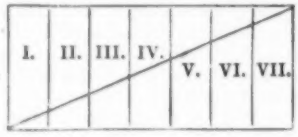
### Fourth Month—April.

### Work to be Prepared.

1. *Reading and Repetition.*—Continual care is needed with these subjects. Failure in reading means failure in the whole examination, and few candidates read well because little thought is given to the subject. Good reading needs as much preparation as good writing or drawing. Exercises in breathing and in voice production are necessary. If you think you are perfect, read the following at a fair pace and let a fellow-student write from your dictation: "Keep lace, keep place; distinct races, distinct traces; shrewd aim, shrewd dame; grief alters, grief falters; glorious ease, glorious seas; see them, seethe them; broken ease, broken knees; blue otter, blue water; the presence of man, the presents of man; axe, acts; the dews fall on the Jews; he built him an ice house which was a nice house." (These examples are taken from Dunstan's *Voice Production*—a very useful book for those who wish to excel.)

2. *Teaching.*—Chap. iii., *Scholarship School Management.*—*The Teaching of Reading.*

The different methods given in the text-book must be thoroughly grasped. Whatever method is employed, remember the aim—to produce clearly and distinctly and with proper voice modulation. The exercise at once divides itself into two parts: (*a*) The mechanical part which depends upon systematic training of eye to recognise, throat and mouth to produce, and ear to judge; and (*b*) the intellectual part—the appreciation and understanding of the passage read, so that the proper emphasis and modulation is given. In the lower standards the greater part of the time is concerned with mechanical reading, in the upper standards with the intellect. The following diagram indicates the proportion of time approximately which should be devoted to each part. The spaces above the line stand for mechanical work, below for meaning, expression, &c.:—




Further analysed—

Good Reading consists of

- I. Mechanical Utterance =
  1. Proper Enunciation of Consonants.
  2. Proper Pronunciation of Vowels.
  3. Proper Accent.
  4. Proper Fluency.
  5. Proper Pitch.
  6. Proper Deliberation.
- II. Intellectual Expression =
  1. Just Emphasis.
  2. Proper Modulation.

The first properties are taught largely by pattern reading, the second come only when the piece is properly understood. Once a child grasps and appreciates the author's meaning there is no necessity to say, "Read with expression"; until the meaning is completely understood just emphasis and proper modulation are impossible.

A heavier responsibility rests on the teacher than the mere teaching to read, namely, the teaching *what* to read. If the result of the school life is to make a boy or girl fond of reading the trashy papers which are sold by the million, they would be better altogether without the art.

3. *Drawing.*—Two copies each week. It seems very difficult to make many candidates understand simple instructions. The Scholarship Syllabus distinctly says that the drawing is to be on half-imperial paper (22 inches by 15 inches), and that it must *not* be the same size as the copy. In the majority of specimens sent in both these rules are broken. Attention must again be called to the remark, "Candidates should have practised drawing from actual objects themselves." If this is not done it is impossible to draw properly from the photo of a cast where the deep shadows hide perhaps some details which should be known. As foliage usually forms part of a copy, studies should be made of sprays of leaves, flowers, &c., as frequently as possible. The best effects are produced by lining in with sepia and brush; the harsh wavy lines are bound to disappear, and a certain amount of freedom necessarily follows. The brush work done by infants and lower standards is far more artistic than the laboured "freehand copies" of older children.

4. *Music.*—Syncopation. Compass of Voices. Common Musical Terms.

The compass of voices is very largely a matter of theory, and it is impossible to assign any particular range to a child of a certain age. Theoretically, the range is as follows:—

Bass, $G_2$ to C; Tenor, $C_1$ to G; Alto, $G_1$ to $C^1$; Treble, C to $G^1$.

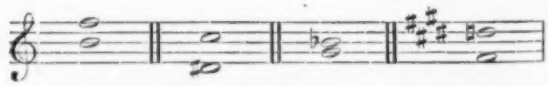
Bass or base is the lower part, tenor (Latin, *teneo*, I hold) the holding or leading part, and treble (or triple) the third or upper part in the old three-part singing. Alto is the high voice of a man. Soprano=treble; mezzo-soprano, a low-set and full soprano; baritone, a high-set bass or low-set tenor. With children the range is developed by practice, young children having a less range than older ones.

The common musical terms must be carefully learned. They are divided into those concerning (*a*) Time, (*b*) Pace, (*c*) Expression. Any text-book will supply a list. The modifying words must also be learned. *Con*=with, *non*=not, *piu*=more, *poco*=a little, *ma*=but, *troppo*=too much.

Work the following:—

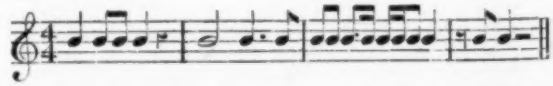
(1) Write the pitch names (C, B, &c.) and the duration names (crotchet, minim, &c.) of the following notes, and write signs for rests of corresponding value—

(2) Name the intervals formed by the following pairs of notes—



(3) Write the signatures of the following keys: B major, F major, A♭ minor, G major.

(4) Rewrite the following in $\frac{4}{2}$ time, doubling the value of every note and rest—



(5) Write the signature and the descending scale of B minor, using the minor seventh and the minor sixth.

(6) Explain the following terms: (1) Rallentando, (2) Vivace, (3) Crescendo, (4) Andante.

5. *Penmanship.*—Write a page daily in the *Practical Teacher* Copy Book, and use great care at all times. "Defective handwriting may be taken into account in estimating the value of a candidate's work," says the syllabus. The specimens occasionally submitted to me are generally poor. There is an entire absence of grace and freedom. This arises from an improper way of holding or using the pen. It is as easy to write well as to write badly.

6. *Composition.*—Write one or two essays each week on such subjects as—

(*a*) The British Constitution.
(*b*) The value of the study of geography.
(*c*) "Words are like leaves; and when they most abound
Much fruit of sense beneath is rarely found."
(*d*) Your favourite pursuit.
(*e*) Friendship: distinguish between its real and unreal forms.
(*f*) The use and abuse of riches.
(*g*) Kindness to animals.
(*h*) "A stitch in time saves nine."

Read up the subject if necessary; at any rate think it over carefully. Arrange your ideas in the form of a skeleton plan of the essay, and having written it roughly, go over carefully and polish and improve it to your best.

The following notes may assist; they are only suggestions as to how the subject may be treated:—

(*a*) Introduce by pointing out the chief forms of government—Patriarchal, Autocratic, Republican, and Limited Monarchy—and show that the last is the best, combining all the advantages of the former with none of the disadvantages. The British Constitution is the result of the growth of centuries, each of the three estates gradually assuming the functions which they should properly have.

(*b*) Many uses are apparent at once—the increase of knowledge, the widening of experience, the extended sympathy, the commercial value, the political value, the valuable means of mental training: each of these can be developed into a paragraph.

(*c*) The meaning here is fairly obvious. If a tree expends all its vigour in producing leaves it cannot produce fruit. Persons who talk loudly and incessantly have rarely anything to say. It is the man that knows least about a question that is surest and loudest in his opinions. The thoughtful student sees too many possibilities and phases of the topic to at once state an opinion. "Speech is silvern, silence is golden." It is rarely found that a great man is a brilliant talker. There are exceptions, *e.g.* Macaulay, who could lecture to a party for hours on any topic, but as a rule the great things in the world are done by the quiet thinkers.

(*d*) State what it is, why you have chosen it, what use it is to you.

(*e*) Friendship generally arises from a similarity in tastes and pursuits, which develops into a deep respect and regard for the person. Acquaintance is not friendship, neither can friendship exist which is not based on mutual esteem and respect. It is not dependent on social position or wealth—"a friend in need is a friend indeed"—it abhors flattery and sycophancy, and flourishes on truth and sincerity.

(*f*) Money is not "the root of all evil," although an inordinate love of it may be. Riches carry with them great responsibilities. If used to pamper the passions, to gratify useless cravings, to supply means of self-indulgence, it is clearly misused; but if it is used to alleviate misery, to help the necessitous, to rescue the fallen, &c., it is being used aright.

(*g*) Animals that have been domesticated have been robbed by man of their natural freedom, and hence the obligation rests on him to supply them with those things with which in a free state they could supply themselves. The moral obligation cannot be assailed—*noblesse oblige*. There is also a lower view, that of expediency; animals properly and kindly treated are of better value and repay the kindness in many ways.

(*h*) Treat this as the usual proverb—its literal application, its figurative meaning, especially as applied to habit.

7. *English.*—(1) Learn fifteen roots and meanings each week.

(2) Read up the common mistakes in the spoken and written language. (See *P.T.'s* English note-book for these.)

(3) The history of the language. The chief Tudor writers.

(4) *Henry V.*, Act II., scenes 3 and 4.

(5) Prepare thoroughly the Essay on Great Place.

(6) The grammar of the Adjective and Pronoun.

(1) The common mistakes in spoken and written language, on which a question is frequently set, are treated fully in the little text-book mentioned. As the ability to detect mistakes is a necessary preliminary to their avoidance, all students should devote some time to their study.

(2) As the language has changed in form but little since the invention of printing stereotyped the spelling, there is little to study in this respect from the sixteenth century onwards. It is interesting to note, however, that the ever-widening scenes of exploration and colonisation increased the vocabulary by words adopted, *e.g.* the revival of learning led to many Italian words being introduced, the Dutch wars to Dutch naval terms, the settlements in North America to the introduction of Indian terms, the conquest of India to the employment of Hindustani terms, &c.

(3) The literature of the pre-Tudor times is scant. Chaucer is practically the only writer of first-rate importance, but before 1603 England possessed a literature of its own, which in quality ranks with any in the world. The student should at least know the names and the chief works of the authors of first-rate importance. Such men as Raleigh, Hooker, Spenser, Shakespeare, Marlowe, Ford, Massinger, Beaumont, More, &c., should receive some attention at the hands of the student of English.

(4) Scene III. is one of the lighter touches introduced with inimitable skill to relieve the attention after it has been devoted to more serious matters. In Scene IV. we are very properly taken to the French court, and are presented with the French view of the situation. The reports that had reached France of the wild and lawless youth of Henry possibly made many believe that his character would be unable to support and direct an international war, although this belief was evidently not shared by all thinking men. The defiance of the messenger when introduced to the French court is not in accordance with our modern notions of respecting an enemy. Empty threats and general "tall talk" do not win battles, but it must be remembered for whom and with what object Shakespeare was writing, and such defiance of foreign powers would sound sweet to the ears of those who had defeated the Armada and for the first time secured for England an independence and position very different from the nightmare of dread of foreign invasion which had troubled the early years of Elizabeth.

(5) The advice given in the Essay on Great Place was eminently suitable to the time in which it was written, when favourites at courts rose rapidly into the most important and powerful places and had to depend on the pleasing of a sovereign's eye for continuance of their position rather than on the general esteem of the nation. There is much shrewd advice given, some of which Bacon himself followed and some of which he did not. It is hard to understand that a man who could write the paragraphs in this essay on "corruption" should disgrace himself by doing the exact opposite to what he advised: "Avoid not only the fault, but the suspicion." Bacon avoided neither, and consequently left his splendid name tarnished by the charge of corruption.

(6) In revising the grammar of the parts of speech, special attention should be given to the more unusual points. A good classification, rules for comparison, &c., must of course be known. The following should also be looked up: The Adjectives which are compared irregularly, and the etymological reasons therefor; Adjectives which do not admit of comparison; distinction between the meaning in such pairs as older, elder; later, latter; some, several; each, every.

The classification of the Pronouns—the difference between reflexive and emphatic pronouns, indefinite and reciprocal pronouns. The derivation of each should be noted, otherwise you cannot answer such questions as, "If the salt has lost *his* savour." Why not *its?* "Go to *it* grandam." Is this correct?

8. *Geography.*—(*a*) Revise Asia generally, its physical features, climate, productions, &c., and Asia Minor and Arabia in detail; (*b*) the British Possessions in Africa, excluding Cape Colony, Natal, Transvaal, Orange River Colony.

(*a*) The revision of Asia should present little difficulty if the work was done properly during pupil teachership. Sketch maps must be freely used—a good large outline might well be drawn and all names inserted which are to be remembered. The key to the whole physical geography is in the mountain system which divides the continent into (*a*) a north-western slope, (*b*) a central plateau, (*c*) a south-eastern slope, and (*d*) a number of detached peninsulas. This is the governing factor in the river systems, in the climate and productions.

(*b*) The possessions in Africa should be tabulated as on following page, and the facts committed to memory.

Egypt, though not a British possession, is so closely connected with the Empire that it should receive particular attention. Although the government is nominally in the hands of the Khedive, the real power is exercised by British officials who advise him, and under their care the financial and social condition of the country has increased enormously.

| Colony. | Area. | Pop. | Imports. | Exports. | Towns. | Government. |
|---|---|---|---|---|---|---|
| Gambia . . . | 2,700 | 13,500 | Cotton goods, kola nuts, rice, and tobacco. | Ground nuts, bees-wax, rubber. | Bathurst. | Crown Colony, Governor and Legislative Council. |
| Gold Coast Colony | 40,600 | 1,000,000 | Textiles, alcohol, hardware. | Gold, rubber, ivory, monkey skins, cotton, timber, cocoa. | Accra, Cape Coast, Ada, Elmina, Kwitta, Akim. | Do. do. |
| Sierra Leone . | 4,000 | 80,000 | Do. do. | Palm kernels, kola nuts, benni seed, ginger, rubber, &c. | Freetown. | Do. do. |
| Sierra Leone Protectorate | 30,000 | 500,000 | Do. do. | Do. do. | ... | Protectorate. |
| Lagos and Protectorate | 26,700 | 500,000 | ... | Generally as above. | Lagos. | Crown Colony. |
| Southern Nigeria | ... | ... | Cotton goods, hardware, cutlery, and spirits. | Palm oil and kernels, rubber, ebony, ivory. | Old Calabar, Opobo, Bonny, Brass, Benin, Akassa. | Protectorate. |
| Northern Nigeria | 500,000 | 20,000,000 | Do. do. (Spirits prohibited.) | Do. do. | Zungeru. | Do. |
| Somaliland . | 68,000 | 300,000 | A few textile and hardware goods. | Practically none. | Berbera, Bulhar, Zeyen. | Do. |
| East Africa Protectorate | 1,000,000 | 4,000,000 | Piece goods, rice, grain, flour, provisions, &c. | Ivory, grain, rubber, and copra. | Mombasa. | Do. |
| Witu Protectorate | 1,200 | 15,000 | Do. do. | Do. do. | ... | Do. |
| Uganda Protectorate | 70,000 | 2,000,000 | Do. do. | Do. do. | Kampala. | Do. |
| Zanzibar Protectorate | 985 | 250,000 | Piece goods, ivory, cloves, rice, coal. | Ivory, cloves, copra, rubber. | Zanzibar. | Do. |
| British Central Africa Protectorate | ... | 750,000 | Soft goods, provisions, and hardware. | Coffee, rubber. | Blantyre, Zomba. | Do. |
| Mauritius . . | 705 | 375,000 | All necessaries of life. | Sugar. | Port Louis. | Crown Colony. |
| Seychelles . . | 148 | 20,000 | Do. do. | Vanilla, cocoanuts, tortoise shells, guano. | Victoria. | Do. |

The Sudan Provinces (capital, Khartoum) are under a Governor-General appointed conjointly by the Egyptian and British Governments. A railway runs to Khartoum (96 hours from Cairo), and steamers run south to Gondokoro.

The history of the occupation of Egypt should be read up.

9. *History.*—The reigns of Henry I. and Stephen in detail and a general revision of the Norman Period.

The text-book supplies the leading facts, which must of course be committed to memory. One of the most important uses of the study of history is, however, the exercise it should give to the reasoning faculties. Hence, in addition to learning that such and such an event occurred, the question must always be asked *why?* What causes led up to it?

Apply this to the period in question.

The following points must be thought out.

1. The difference between Saxon and Norman Feudalism.

In the former the land was the tenant's, there was no exact stipulation to fight, and the feudalism went upwards, *i.e.* the people chose leaders, and the leaders the king.

In the latter the land was the lord's, the tenant was bound to fight, and the feudalism came from the king downwards.

2. What caused the Crusades, and what were their effects upon Western Europe, on the particular countries, and on the Church? The Crusades failed entirely in their object, viz., to hold the Holy Land as a Latin and Christian kingdom—the distance was too great, the upkeep of armies too costly, the Crusaders were few, the Saracens many. The results were:—

(1.) The Church attained greater power and acquired many estates cheaply.

(2.) The Barons bore the great expense, and often had to sell their lands or mortgage them to pay their debts.

(3.) Commerce between East and West was largely developed.

(4.) At home, the towns gained. Many bought their freedom from the feudal lord, the merchants did well by trade, and the troublesome barons were out of the way.

(5.) Learning was introduced from the East, and also eastern diseases—leprosy, cholera, &c.

3. What caused the Investiture Dispute?

This is often a point imperfectly understood. The usual answer is that the dispute was over the appointing of bishops and giving a ring. This is true, but there was much more behind it. If the Pope appointed the bishops and abbots (who, it must be remembered, were great landowners), then the king lost part of the feudal dues which he should have received and had practically part of his country under a foreign jurisdiction. In the end the Norman king obtained what he fought for—the right to invest the bishop with his temporal possessions.

4. Note Henry's Charter, think out how his weak claim to the throne was a good thing for the native English.

5. What lessons were taught by the Civil War?

(*a*) The necessity of a strong sovereign.

(*b*) That the feudal system without effective control was a most dangerous institution.

(*c*) That the king and the people should be united against the too powerful barons.

10. *Arithmetic.*—Proportional Parts, Partnerships, and Miscellaneous Examples (Exercise 91, Christian and Collar). There is little difficulty in Proportional Parts or Partnership, and what there is is fully explained in the text-book. Care must be taken in questions where the proportion of time is given to get the right proportion for the work. *E.g.* "3 men do a piece of work for £4, 14s. Separately they could do it in 15, 20, 25 days. How should the money be divided?" A very little thought will show that the money is not divided in proportion to the time, or the man that took longest would receive most. The ratio required is the inverse of this, viz., $\frac{1}{15} : \frac{1}{20} : \frac{1}{25}$.

The Miscellaneous Exercise (Ex. 91) should be very carefully studied. All the sums are of a common type in exam. papers. If any difficulty is experienced, send a post-card for explanation. Every sum must be done.

11. *Algebra.*—Operations with Algebraic Fractions—Addition, Subtraction, Multiplication, and Division. They are easy *only* if the factors are thoroughly mastered. It is very rare to meet with a complicated fraction where by means of factoring and cancelling much time cannot be saved. Note that $a - b$ will divide into $b - a$ $-1$ times.

Work the following paper:—
Simplify the following—

(1) $\frac{a^6+b^6}{a^6-b^6} \times \frac{a-b}{a^2+b^2} \div \frac{a^4-a^2b^2+b^4}{a^4+a^2b^2+b^4}$ Ans. $\frac{1}{a+b}$.

(2) $\frac{\frac{m^2+n^2}{n}-n}{\frac{1}{n}-\frac{1}{m}} \times \frac{m^3-n^3}{m^3+n^3}$ Ans. $m$.

(3) $\frac{1}{2(x-1)} - \frac{x-5}{x^2-7x+10} + \frac{1}{2x^2-9x+18} \frac{x-6}{}$
Ans. $\frac{1}{(x-1)(x-2)(x-3)}$.

(4) $\frac{(a+b-c)^2-d^2}{(a+b)^2-(c+d)^2} + \frac{(b+c-a)^2-d^2}{(b+c)^2-(a+d)^2} + \frac{(c+a-b)^2-d^2}{(c+a)^2-(b+d)^2}$
Ans. $\frac{a+b+c+3d}{a+b+c+d}$.

(5) Find the value of
$\frac{a+b+2c}{a+b-2c} + \frac{a+b+2d}{a+b-2d}$ when $a+b=\frac{4cd}{c+d}$ Ans. 2.

(6) If $\frac{x}{a-b}=\frac{y}{b-c}=\frac{z}{c-a}$ then will $x+y+z=0$.

Many replies were sent in to the two little problems set last month. The majority failed to see the mistake. In the first, when each side is cancelled by $(x-x)$, this is equivalent to dividing each side by 0, and the result is infinity. *E.g.* $5\times0=6\times0$, but this does not make $5=6$.

In No. 2 many simply pointed out what was evidently a printer's error: $\frac{4}{2}$ in the first bracket should have been 4. The fallacy in this depends upon ignoring the sign of the square root; the square root of 4 is not 2, but $\pm2$. So in the sum in question, if the sign be taken as $\pm$ in each case it works out $4=4$ or $5=5$.

(*Women*).—Multiplication. Work the examples in Scholarship Mathematics for Women (W. B. Clive & Co.).

12. *Euclid.*—Book I. Propositions 17–20 with 4 deductions each week. Prove the following:—

(1.) The three straight lines drawn from a point within a triangle to the angles, are together less than the perimeter but greater than its half.

(2.) Inscribe a square in a given equilateral triangle.

(3.) Prove Euclid I. 17 without producing a side.

(4.) Construct a right-angled triangle, having given the hypotenuse and the sum of the sides.

(5.) Given the hypotenuse of a right-angled triangle and the point where the perpendicular from the right angle cuts the hypotenuse, to construct the triangle.

(6) Prove that the four triangles in which a parallelogram is divided by its diagonals are equal.

(*Women*).—Learn Propositions 6, 7, 8, and 9, and work the following deductions:—

(1.) Describe an isosceles triangle having each of the equal sides double of the third side.

(2.) If the diagonal of an oblong be drawn the alternate angles are equal.

(3.) The diagonals of a rhombus intersect at right angles.

13. *Science.*—Conduction and convection. Changes of state caused by heat. Radiation. Work as many of the simple experiments as you can.

14. *Spelling.*—Learn 100 words per week from "Words commonly misspelt."

## Test Questions.

*English.*—

1. Chaucer has been called "the founder of our fair language." Explain this fully.

2. Paraphrase the following passage:—

> Treason and murder ever kept together
> *As* two yoke-devils sworn to *either's* purpose
> Working *so* grossly in a natural cause,
> That admiration did not hoot at them:
> But thou, 'gainst all proportion, *didst* bring in
> Wonder *to wait* on treason and on murder:
> And *whatsoever* cunning fiend it was
> That wrought upon thee so preposterously
> Hath got the voice in hell for excellence.

3. Analyse the above and parse the words in italics.

4. Write an essay criticising Bacon's ideas on Marriage.

5. Comment on the number of words *Eaves, alms, news.* Give examples of nominative and objective absolute, residual object, cognate and factitive object.

6. Give the meaning and the origin of the following prefixes and suffixes:—

(*a*) Prefixes. *a* in away, aware, ago.
*for* in forsake, forlorn, forgive.
*un* in uncouth, unto, undo.

(*b*) Suffixes. *ment* in parchment, parliament.
*some* in handsome, wholesome.
*ster* in spinster, maltster.

*Geography.*—1. Describe a fortnight's holiday in Switzerland.

2. What are the chief vegetable products of Europe? Whence do we obtain supplies of currants, olives, wheat, sugar, wine, timber, fresh fruit?

3. Give a clear account of the government of India, and point out in what way our occupation of the country has been beneficial to it.

4. Say what you can of the following:—Elephanta, Alhambra, Kremlin, Acropolis, Taj Mahal, the Coliseum.

5. Write a short essay on the character of the trade between India and the British Isles.

*History.*—1. Describe the successive stages by which William I. completed the conquest of England. What special circumstances or otherwise made this easy of accomplishment?

2. Compare the Feudalism of 1089 with that of 889. What was the importance of the Salisbury Decree?

3. Explain clearly what is meant by Feudal incidents.

4. In what manner and for what purpose was the Doomsday Book compiled?

5. Say what you can of the religious, social, and commercial effects of the Crusades.

*Arithmetic.*—In a division sum the quotient, divisor, and remainder are in the proportion of 7 : 5 : 3, and the sum of the three together amount to 1274. Find the dividend.
Ans. 253·130.

2. A garrison has sufficient food to last for 23 weeks at the rate of 18 oz. per man per day, but receiving a reinforcement of 40 per cent. upon their original number this allowance is reduced to 15 oz. per day. How many days will they be able to hold out? Ans. 138 days.

3. Divide £180 among A, B, and C, so that A may receive 3 times as much as B, and B and C together may receive half as much as A. Ans. £120, £40, £20.

4. If £5 be divided among 6 men, 12 women, and 17 boys, so that 2 men may receive as much as 5 boys, and 2 women as much as 3 boys, how much will each man, woman, and boy receive? Ans. 5*s.*, 3*s.*, 2*s.*

5. Find a fraction, the third part of which shall bear the same ratio to $\frac{3}{7}$ that $\frac{1}{14}$ does to the third part of $\frac{1}{42}$.
Ans. $3\frac{3}{16}$.

6. A person fills a glass with wine and drinks one-third; he fills it up with water and drinks one-fourth; he fills it up again and drinks one-half. What fraction of the whole glass remains wine? Ans. $\frac{1}{4}$.

*Science.*—1. Distinguish between heat and temperature, and describe some means by which each can be measured.

2. What is the mechanical equivalent of heat.

3. Describe exactly how you would make a mercurial thermometer, and what particular properties it should possess.

4. Why is it colder at the top of a mountain than at the bottom?

The answers to these questions will be marked at a nominal fee to subscribers.

## PUPIL TEACHERS' COURSE

*For Entrance Examination, 1905.*

1. *Reading and Repetition.*—These subjects should now be nearly ready for the examination. Regular *oral* practice is very necessary.

2. *Penmanship.*—Write a page daily in the *Practical Teacher Copy Book*, and use great care at all times.

3. *English.*—This month had better be spent in a thorough revision.

The following questions have all been set to pupil teachers, and will serve as a test of knowledge.

(1.) State the distinction between strong and weak verbs, and give the past tense and participles of the following:—Creep, keep, teach, reach, flag, pay, stay, read, lead, tread.

(2.) What is meant by auxiliary, defective, transitive, and intransitive verbs?

(3.) What is the plural of each of the following:—Brother, sow, calf, sheep, ellipsis, penny, memorandum.

(4.) Explain how prepositions may be distinguished from adverbs. Give examples of the same word used in one sentence as a preposition and in another as an adverb.

(5.) What is case? How do you recognise the nominative, possessive, and objective cases?

(6.) What is meant by passive voice? What verbs have no voice?

(7.) What is meant by gerunds? How would you distinguish them from participial adjectives and participles?

(8.) Explain the nominative absolute and the nominative of address.

(9.) What may the subject and the object of a sentence consist of?

(10.) Give some examples of collective nouns, and say which of them should be followed by a singular and which by a plural verb. Give your reason.

(11.) Classify the pronouns, and give sentences illustrating the use of each kind.

(12.) Put each of the following words in a sentence so that it shall be followed by an appropriate preposition: Conform, different, free, absolve, resolve, differ.

(13.) Point out the different ways of extending the predicate of a sentence, and give examples of each.

(14.) Define a complex and a compound sentence, and give three examples of each.

(15.) Say what is the significance of each of the syllables printed in italics in the following words, and give in each case two other words similarly formed: *im*proper, *re*fer, instruc*tion*, audi*ble*, *sub*marine, *per*forate, *e*volve, longi*tude*, *noncon*formist.

(16.) Make a list of words having the following beginnings and endings, and give the meanings in each case: Per-, contra-, ex-, con-, mis-, ab-, anti-, sub-, -fy, -tude, -ive, -ble, -or, -ure, -ity.

(17.) Explain the meaning and use of the syllable printed in italics in each of these words: *Sub*terranean, *inter*dependence, priest*hood*, critic*ise*, first*ling*, silken, *for*bid, *dis*similar, *post*script.

(18.) Give the Latin prepositions which mean *out of*, *from*, *under*, *without*, *across*.

(19.) Take each of the following words and add to it a prefix or a suffix. Explain in each case what change in the meaning of the word has been effected by the additional syllable:—

| | | | | |
|---|---|---|---|---|
| just | admire | faith | pure | brother |
| friend | sincere | wise | hard | speak |

(20.) Write out a list of words compounded or derived from the Latin verbs: amo, duco, fero, audio.

Write an essay each week on such subjects as: British love of sport. Courage—physical and moral. Colonisation—its use. Money: its uses and abuses. A ship on fire.

4. *Geography.*—The countries of Asia, their chief towns, governments, imports and exports, paying especial attention to India. See last month's Scholarship Course for notes thereon. Particular care should be taken with Japan and Manchuria. A map of the latter should be learnt, and a brief and clear account of the causes of the present war. Draw a sketch map for each country, and insert in it the names of all places to be learned. "Where and what are the following," is a common type of question.

For revision purposes use Test Questions in History (Meiklejohn & Holden).

5. *History.*—Mary and Elizabeth.

The reign of Mary is mainly occupied with the persecutions. The attempts of Northumberland to place Lady Jane Grey on the throne; Wyatt's rebellion; relations with France and Spain, are the other chief points.

The reign of Elizabeth is very important. The chief points to be noted are:

(1) The establishment of the Protestant religion.

(2) England's relations with France, Spain, and the Pope during the early years when England was powerless to repel invasion. France and Spain were cajoled at first by Elizabeth's proposals to marry a French or Spanish noble, and afterwards hindered by the help given to the Netherlanders against Spain, and to the Huguenots against France.

(3) Mary Queen of Scots: her life and death. How far was Elizabeth justified in having her executed?

(4) The Armada—the cause of its coming, its defeat, and the results.

(5) The "Sea Dogs" and their doings.

(6) The chief writers.

(7) The vagrancy question, and attempts made to deal with it, ending in the great Poor Law.

(8) Affairs in Ireland.

6. *Arithmetic.*—Work any general exercises on the syllabus, make sure of the definitions of terms employed, and the theory of fractions, ratio, and proportion. The metric system should be thoroughly mastered.

7. *Algebra.*—Simple equations and problems leading thereto.

8. *Euclid.*—Revise the whole thoroughly.

9. *Science.*—Finish the text-book, look over questions that have been asked and read up any weak points.

### Test Questions (*continued from last month*).

Answers will be marked gratis if sent direct to Mr. A. T. Flux, Oakleigh, Belvedere, Kent, with stamped addressed envelope enclosed for return. The coupon of the current number must be enclosed.

*English.*—1 hour. Answer three questions.

1. Write a short essay upon the following subject—War.
2. Paraphrase.
3. Analysis and parsing. } Taken from the special book set.
4. Explanation of three passages. }
5. Show how the difference in meaning of describe, ascribe, inscribe, prescribe, is due to the prefix. What is the derivation of *scribe*? Give any other words formed from it which you know and explain their meaning.

*Elementary Science.*—½ hour. Answer three questions.

1. Water, alcohol, and mercury are heated from a temperature of 1° centigrade to a temperature of 20° centigrade. How can you prove that these liquids expand at unequal rates?

2. The glass stopper of a glass bottle is found to be jammed. Describe some method by which it may be extracted. Explain the principle on which your method is founded.

3. Describe and explain an experiment by which you can show that it is possible to have boiling water and ice together in the same test tube.

4. A straight line is drawn on a piece of paper, part of the line is covered by a thick piece of plate glass. To an eye in most positions the line appears to be broken. How do you explain the fact? Illustrate your answer by a diagram.

5. What colour would a red rose appear if green light only fell upon it? Give any explanation you think necessary.

*Euclid.*—½ hour. Answer two questions. Most credit is given for answering Question 2.

1. Define a line, a straight line, and a finite straight line. Bisect a given finite straight line.

2. When are two straight lines said to be perpendicular to each other? Prove that the greater angle of every triangle has the greater side opposite to it. Also show that the shortest line drawn to a given straight line from a given point without it is the perpendicular to the line from the point.

3. Define a rectilineal angle. Make a rectilineal angle equal to a given rectilineal angle.

*Algebra.*—½ hour. Answer three questions.

1. Simplify $\{6(x+a)+5y-6a\}\{8(x-a)-2(x-4a)\}$
2. Divide $(a-b)^2x^2-(a^2-b^2)x$ by $-(a-b)x$.
3. There are three successive whole numbers such that the square of the last exceeds the square of the first by 100. Find the numbers.
4. Solve the equation

$$\tfrac{2}{3}(x-\tfrac{1}{3})=\tfrac{1}{2}-\tfrac{1}{7}.$$

## OUR CERTIFICATE COURSE FOR 1905.

BY GEORGE COLLAR, B.A., B.SC.,
*Head-Master of Stockwell Pupil-Teacher School.*

### TEST QUESTIONS ON LAST MONTH'S WORK.

THEORY OF TEACHING.

1. Explain the steps you would take in teaching a class how to find the G.C.M. of two numbers.

2. Explain as to a class the method of abbreviating the work

of long division in decimals in order to obtain a result correct to a given number of significant figures.

3. Give the rules that should be observed in the lighting of a class-room.

### English Literature.

1. In what ways had the Court sought to extend its "influence" in Burke's time.

2. Explain the phrases: *Mettre le roi hors de page; Talking prose; However they may hire out the usufruct of their voices, they will never part with the fee and inheritance; A back-stairs influence.*

### English History.

1. Discuss the causes which led to the outbreak of the American War of Independence.

2. Sketch the history of the British navy during the reign of George III.

3. Into what alliances did Great Britain enter against the French between 1790 and 1815, and in what ways did she co-operate with her allies?

### Geography.

1. Tunis, Algeria, Ashantee, Congo Free State, Dahomey. Give the positions of the above, stating to what European Power each is subject, or into whose "sphere of influence it falls." Write a few notes about any two of them.

2. Explain and illustrate the meaning of five of the following expressions: Buffer State, Hinterland, Neutral Zone, Sphere of Influence, Treaty Port, The Open Door, Most Favoured Nation, The Roof of the World.

### Arithmetic.

1. (*a*) What percentage of £3, 6s. is represented by $\frac{1}{175}$ of £99?

(*b*) A certain trade increases in volume by one-fourth, and then recedes to its former bulk.

(1) How much was the increase per cent.?

(2) How much was the subsequent decrease per cent.?

2. A tram company find that they carry on Saturday 50 per cent. more passengers every hour than on Friday. On the latter day the trams run 16 hours, the average fare is 1·365 pence, and the takings £468. On Saturday they run 17½ hours and take £855. What is the average fare paid?

### Geometry.

1. If from a point without a circle any straight line be drawn cutting the circle, the rectangle contained by the whole line and the part outside the circle is of constant area.

If the diameter of the earth be 8000 miles, find approximately the greatest distance from which the light of a lighthouse 100 feet high can be seen from the level of the sea, assuming that light travels in straight lines.

2. Of all the triangles upon the same base whose areas are equal, the isosceles triangle is that which has the least perimeter.

### Algebra.

Solve the equations:—

(i.) $$\begin{cases} \dfrac{x}{p-q} + \dfrac{y}{p+q} = \dfrac{p^2+q^2}{p^3-q^3} \\ x+y = p+q \end{cases}$$

(ii.) $amx - \dfrac{nx}{b} = bx - c.$

(iii.) $$\frac{\sqrt{3x+1} + \sqrt{3x}}{\sqrt{3x+1} - \sqrt{3x}} = 4.$$

(iv.) $(x-3)(x-2)+(x-2)(x-1)-1=1-(x-3)(x-1).$

### Elementary Science.

1. What do you understand by a storage product? Illustrate your answer by reference to instances which you have encountered, both in animal and vegetable growth.

2. Two acorns are allowed to germinate, one in the neck of a bottle full of water, and the other in an ordinary flower-pot. What differences will be noted in the two plants as they grow?

## SYLLABUS AND HINTS FOR APRIL.

### English Composition.

Study carefully the section on Reflective Essays in Nesfield's *Senior English Composition*. Analyse these outline essays and then reproduce them, or build up essays on your abstract; or take Meiklejohn's *Art of Writing English*, chapters xviii., xix., and xx.

Prepare and write essays on the following subjects:—

1. Better to wear out than rust out.
2. The North Sea Incident.
3. International Arbitration.
4. Wireless Telegraphy.
5. Adaptation of the form of animals to their habits.

### Theory of Teaching.

Study the chapter on Elementary Science and Object Lessons.

Not only is it essential that the architect of the school should be a specialist and make provision for every convenience in the building itself, but the furniture must be specially adapted for scholastic use, as much harm may come to growing children by working in unsuitable desks. The height of the seat should be equal to the distance from the sole of the foot to the knee, equal, according to careful estimates, from three-elevenths to two-sevenths of the height of the pupil. It should be sloped gently backward, and its edges should be rounded. The back rest should be such as to give support to the back under the shoulders and above the hip bones. The height of the desk above the seat should be such that the pupil sitting erect can easily place his forearms on the desk without changing the natural position of the shoulders. For writing, the seat should project about two inches under the desk; for other purposes the front edge of the seat should be vertically under the back edge of the desk; it may project a little under the desk, but should never be farther back. The slope of the desk should be about 25° to 30° for writing, and 45° to 50° for reading. The necessity of having desks of different dimensions for pupils of different sizes, and for the same pupil when engaged on different subjects, leads to the recognition of the superiority of adjustable desks over fixed desks.

In considering the supply of blackboards school authorities should endeavour to reduce the amount of dust to a minimum. Tablets of natural slate can be fixed round the wall, or tablets of framed plate glass, ground in front and painted black behind, are very useful, and as they can be very easily cleaned with a slightly damp duster, they give rise to practically no dust. Moreover, they never have that shiny surface that an ordinary blackboard acquires after a little use.

Care should be taken that the maps used are not crowded, and that they are placed near the pupils and in a good light.

For young children no reading books should be used which are printed in a type smaller than "Pica," and for pupils of any grade the type should not be smaller than "Long Primer."

This is Pica.

This is Long Primer.

The use of slates in school is fast going out in this country. The only thing in their favour is their cheapness. The ease with which alterations can be made leads to habits of carelessness, and even of dishonesty, and unless great care is taken to see that damp sponges are provided *and used*, they lead to an uncleanly way of removing the work from them. This is not only uncleanly, but is a source of danger of infection, so is the practice of putting pencils and penholders in the mouth. Even the use of the same drinking vessel by all the pupils is a source of danger. In some of the schools in America no drinking cups are provided at all, but the drinking water rises in a fountain about three or four inches high, and the children drink direct from this. In other cases each child has a drinking cup for his own individual use. In some schools in which drinking cups are used in common the vessels are disinfected every night with sulpho-naphthol. In any case it is a matter in which great care should be exercised. In one American school all pens, pencils, and other articles that are used by several pupils are put away at night in an airtight chest in the bottom of which is a sponge

soaked in formaldehyde. The vapour from this effectually destroys any germs there may be on the articles.

Recent investigations into the state of the eyesight of school children have led to alarming discoveries. Many cases of faulty vision are of course due to heredity, but after making all deductions enough remains to show the great need of care on behalf of the teacher. We have dealt with the correct method of lighting a class-room, and if a teacher should be unfortunate enough to have a room lighted from the front he should take care to place the blackboard and maps well to the side, and never between two windows. Children are frequently allowed to put their eyes too near their work, especially in the writing lesson. This not only leads to curvature of the spine and weakness of the chest, but makes the vision become shorter and shorter. The normal distance for ordinary print and script is from ten to twelve inches, and it is a good plan to provide the pupils with 12-inch rulers, and insist that those who put their eyes too close shall from time to time measure the distance by putting the ruler between their eyes and their work. If the weather is dark all reading and writing should be suspended, and the time devoted to mental work.

### English Literature.

Continue the study of Burke's *Thoughts*.

36. Having considered the topics let us consider the nature of the Court party.

37. The party is formed with the idea of intercepting the favour, protection, and confidence of the Crown in its passage to its Ministers, of intruding itself, in fact, between the King and his Government.

38. They induce statesmen to form an Administration, and then desert them, and cause them to retire with loss of honour by setting their own officers against them.

39. They form at least two parties in the Administration which weaken one another and the whole by their jealousies.

40. A Minister who opposes his colleagues is applauded.

41. He then has to be shown his own weakness and his dependence on the Court, not on his abilities, for continuance in office.

42. The Cabal work the destruction of an adverse connection by means of a person who is trusted by this connection, who in turn is destroyed by some trusted adherent.

43. Matters are so contrived that people have a greater hatred to the subordinate instruments (Ministers) than to the principal movers (Court party).

44. So on the other hand they bring about the advancement of their own friends through the hands of the Ministry, yet teach these friends to declare that they are under no obligation to the Ministry for their appointments.

45. When an odious job has to be done they cause it to be carried out by those whose reputation will suffer most by their being known to be connected with the job.

46. If the Administration has shown any remissness in punishing disorders the Cabal sets up one of its creatures to clamour against the Ministry for betraying the dignity of Government.

Note.—After the Middlesex election the House of Commons refused to admit Wilkes and declared Colonel Luttrell to be duly elected. The Court party could get no eminent lawyer to defend this action and persuaded Charles York to accept the Lord Chancellorship. He was so ashamed of himself afterwards that he committed suicide. The mob who supported Wilkes went to excesses of all kinds.

47. The members of the Court party do not aim at any high office themselves; they are content with posts, generally with high salaries, about the Royal household. Yet such is their influence that whenever they oppose the ostensible chief he is bound to give way.

48. By avoiding the slippery posts of government they secure posts tenable for life.

49. By their subservience to the Court party they acquire a certain amount of freedom in their dealings with other men.

50. The members of this party call themselves *King's men* or the *King's friends*, as though his Majesty's most loyal subjects had no claim to such a title.

51. Every public man will bear witness to the correctness of the above statements. In the time of the present Administration the faction has arrived at such a height of power and of boldness in the use of it as may perhaps bring about its total destruction.

52. The Rockingham Ministry of 1765 tried to carry on its work without the concurrence of the Court party, of which it thereby incurred the enmity.

53. The abuse hurled at the Earl of Bute is resentment turned in a wrong direction. The party existed, and would have existed, apart from Lord Bute and his personal ambition.

54. Lord Bute also keeps himself in the background and acts through his creatures, and many act under Court direction who are not in connection with him.

55. The infusion of a system of favouritism into the Government has raised the present ferment in the nation.

56. Favouritism is inconsistent with our system of Government. "The discretionary powers which are necessarily vested in the Monarch . . . should all be exercised upon public principles and national grounds, and not on the likings or prejudices, the intrigues or policies of a Court." True policy should seek to place power in the most worthy hands.

57. The executive department of Government should correspond to the legislative. If good laws are made good officers must see that they are carried out.

58. The first duty of Parliament is to refuse to support the Government until power is in the hands of persons who are acceptable to the people. The people by their representatives make the laws, the King has the right of veto. The King makes the appointments of the executive, the people, by refusing to support unsuitable men, have a veto over the appointments.

59. The State should have the ability to prevent bad men from getting into office as well as that of punishing those who abuse their trust.

60. Candidates for office should have given proof of their proficiency.

61. They should have some sway among the commercial or landed interest so as to keep a connection with the interests of the people.

62. So knots and cabals ought never to be suffered to domineer in the State.

63. The will of the Crown should not be a sufficient qualification for office. If popular service be the road to power that will be the road that men will take.

### English History.

Study the reigns of George IV. and William IV., and the first part of the reign of Victoria.

We must say a few words about the great "Industrial Revolution" which began in England about the beginning of the reign of George III. and continued through the greater part of the nineteenth century. Up to 1764 spinning had been done by hand, but in that year Hargreaves invented his spinning jenny, and patented it in 1770. This was a frame containing a number of spindles worked by machinery, and capable of spinning as many threads at once as there were spindles, instead of one at a time as could formerly be done by hand. In 1769 Arkwright invented his water frame, a spinning machine worked by water power. In 1776 Crompton invented his "mule," which combined the chief features of the two, and which soon superseded them. An automatic action was applied to this in 1792 by Kelly, and improved by Roberts, but it did not come into extensive use till 1820.

These inventions for the production of yarn or thread were soon combined with improved machinery for weaving it into cloth. The first important development in weaving machinery was the invention of the power-loom by Cartwright in 1785. Whitney's cotton gin invented in 1815 greatly increased the available raw cotton.

These machines were originally worked by water wheels, but in 1769 James Watt patented his steam-engine, and the Age of Steam began by the application of this motor power to manufacturing machinery. More strictly speaking, steam was first employed in working pumps for draining mines and for raising coal and ore. The impetus given to the cotton manufacture is shown by the fact that the import of raw cotton increased from 1,000,000 lbs. in 1760 to 56,000,000 lbs. in 1800, and 400,000,000 lbs. in 1840. The demand for iron to construct this machinery, and for coal to drive it, led to greatly improved methods of mining and of working iron. It is true that the use of coal in smelting iron dates back from 1735, but the great increase in the production of iron was closely associated with the development in the manufacture of cotton and woollen goods, and the iron industry left the wooded districts in the south and took its seat on the coal fields.

Before the introduction of water and steam power, the manufactures were carried on in the homes of the workers, but the changes led to the introduction of the factory system, and to the establishment of the industries in towns and on coal fields which henceforth became centres of population. The changes led to

many troubles and evils; at first much misery was caused among the operatives, who were thrown out of work. An excessive number of women and children came to be employed in the factories, and there was no factory legislation to protect them and the men from excessively long hours or unhealthy conditions of work. These troubles led to the Luddite riots in 1812 and 1816, in which much machinery in Nottinghamshire and the other Midland Counties was destroyed. Similar riots were in 1826 directed against the power looms in Lancashire.

Another important factor in the development of the manufacturing industries was the improvement in the means of transport. John Macadam (1756–1836) devised great improvements in the method of road-making, and an engineer named Brindley, in face of great difficulties, succeeded in making a canal from the Duke of Bridgewater's mines at Worsley to Manchester. Other canals were constructed soon after this, viz.: The Grand Trunk joining the Trent and Mersey, the Kennet and Avon Canal joining the Thames and Bristol Avon, the Grand Junction Canal, besides canals crossing from Hull to Liverpool and to Bristol. It is a pity that these canals have mostly passed into the hands of railway companies and impediments put in the way of their full use.

Various circumstances greatly hindered foreign nations in the commercial struggle, so that England far out-distanced all her rivals.

The wars with France led to great trouble, but in spite of this the English manufactures and commerce continued to advance, and Napoleon failing to establish his mastery over the seas tried to strike at this country through her commerce, and this endeavour led to the famous Berlin and Milan decrees, which eventually set the Continent against Napoleon and led to his downfall.

### Geography.

Study the physical geography of America.

### Arithmetic.

Prepare the chapters on Discount and Stocks.

The following question was set last year: An investor buys £45 stock at 85½ in a company paying 3½ per cent., £185 stock at 24 in another paying nothing, lends £55 at 4½ per cent., and puts £69 in the 3½ per cents. when they stand at 104. How much per cent. will his money bring him?

We have first to find his total outlay and total income.

(*a*) £45 stock at 85½ costs $\frac{45}{100}$ of £85½ and brings in $\frac{45}{100}$ of £3½, *i.e.* £45 stock at 85½ costs £$\frac{9}{20}$ of $\frac{171}{2}$ and brings in £$\frac{9}{20}$ of $\frac{7}{2}$.

(*b*) £185 stock at 24 costs $\frac{185}{100}$ of £24, *i.e.* £$\frac{37\times 6}{5}$, and produces £0.

(*c*) £55 (cash) lent at 4½ per cent. produces $\frac{11}{\frac{100}{20}}$ of £$\frac{9}{2}$ = £$\frac{99}{40}$.

(*d*) £69 (cash) invested in 3½ per cents. at 104 produces £$\frac{69}{104}$ of $\frac{13}{4}$ = £$\frac{69}{32}$.

∴ the total money invested = £$\frac{9\times 171}{20\times 2}$ + £$\frac{37\times 6}{5}$ + £55 + £69 = £38, 9s. 6d. + £44, 8s. + £55 + £69 = £206, 17s. 6d.

The total income = £$\frac{9\times 7}{20\times 2}$ + £0 + £$\frac{99}{40}$ + £$\frac{69}{32}$ = £1, 11s. 6d. + £2, 9s. 6d. + £2, 3s. 1½d. = £6, 4s. 1½d.

If £206, 17s. 6d. produce £6, 4s. 1½d. then £100 will produce

$$\frac{100}{206\frac{7}{8}} \text{ of } £6\frac{33}{160} = \frac{\frac{1}{5}}{\frac{1655}{331}} \text{ of } £\frac{993}{160} = £3.$$

Answer, 3 per cent.

The student must be very careful to distinguish between cash and stock. The confusion seems to arise from the fact that in stating the nominal value of a quantity of stock the symbol £ is employed, *e.g.* £45 stock, while it is not used in quoting the price paid for £100 stock, *e.g.* stock at 85½, stock at 24.

### Algebra.

Study the chapters on ratio and proportion.

Questions in the arithmetic section can often be very readily solved by the use of algebraical formulæ and methods. These *must* be employed when the "shortest method" is asked for, *e.g.* *Find the square root of* $(7\cdot163)^2+2\times 7\cdot163+1$.

This corresponds with $a^2+2ab+b^2$, where $a=7\cdot163$ and $b=1$, and therefore its square root is $7\cdot163+1$, that is $8\cdot163$.

*Divide* $(3\cdot1415)^2+4\times(3\cdot1415)+3$, *by* $4\cdot1415$.

Of course $4\cdot1415=3\cdot1415+1$.

Now $a^2+4a+3=(a+1)(a+3)$

$\therefore (3\cdot1415)^2+4\times(3\cdot1415)+3=\{(3\cdot1415)+1\}\{(3\cdot1415)+3\}$

and $3\cdot1415+3=6\cdot1415$. *Ans.* $6\cdot1415$.

*Simplify* $\left(\frac{315}{124}+\frac{62}{315}\right)^2-\left(\frac{315}{124}-\frac{62}{315}\right)^2$.

This depends on the identity $a^2-b^2=(a+b)(a-b)$

$$\therefore \left(\frac{315}{124}+\frac{62}{315}\right)^2-\left(\frac{315}{124}-\frac{62}{315}\right)^2$$

$$=\left\{\frac{315}{124}+\frac{62}{315}+\frac{315}{124}-\frac{62}{315}\right\}\left\{\frac{315}{124}+\frac{62}{315}-\frac{315}{124}+\frac{62}{315}\right\}$$

$$=\left(2\times\frac{315}{124}\right)\times\left(2\times\frac{62}{315}\right)=2.$$

The above questions were asked last year in the paper for women as well as in that for men, and this shows the great advantage of a knowledge of elementary algebra to women.

### General Elementary Science.

We shall now deal with some of the questions that were set last year.

1. *A saucer containing water is left to evaporate on a window-sill. Explain the atmospheric conditions which will favour or retard the disappearance of the water.*

We assume that the saucer is out of the reach of falling rain, otherwise during rain the quantity of water would actually increase. The chief atmospheric condition which affects the evaporation is the relation between the temperature and the amount of watery vapour in the air. If the amount of aqueous vapour in the air remains the same, the higher the temperature the more rapidly will the evaporation go on; while if the temperature remains the same, the evaporation will proceed more rapidly the less the quantity of vapour present in the air. But, as we said above, it really depends on the relation between the two. For every temperature there is a fixed maximum quantity of vapour that the air can hold, and the more the quantity actually present falls below this maximum the more rapidly will evaporation go on.

Another important condition is the state of rest or motion of the air. If a little water be placed in a bottle it begins to evaporate, and if the bottle is stoppered or corked, the air above the water is very soon saturated and no further evaporation can take place. If, however, the stopper be withdrawn, some of the vapour from inside the bottle diffuses into the outside air, and the water gives off more vapour to supply its place. So in the case before us, if the air is absolutely still, the air above the saucer becomes charged with vapour which can only pass away by the comparatively slow process of diffusion, and so it hinders further evaporation. But if there is a wind blowing, the vapour is rapidly removed from the neighbourhood of the saucer and evaporation proceeds more rapidly.

2. *Explain how it is that a boy can make a hard snowball from soft snow.*

Snow consists of small crystals of ice. If the snow is kept at a temperature well below 32° F., it remains in separate crystals and exhibits no tendency to "bind." When the boy presses particles of snow together they begin to melt, for 32° F. is only the freezing point at atmospheric pressure, and is above the freezing point at the increased pressure. In melting the snow uses up heat, and so the mass falls in temperature; but when the pressure is taken off, the water thus formed at once freezes, for it is below the freezing point at the reduced pressure. Hence the particles of snow are frozen together into a solid mass.

The student should read up the paragraphs in the text-book dealing with latent heat and with the effect of alterations of pressure upon freezing point. Its effect on the boiling point is generally remembered, but students are apt to forget that the freezing point is also dependent on pressure.

# OUR SCIENCE SECTION

☞ **Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this number.**

## CHEMISTRY.

### (ADVANCED AND HONOURS.)

BY C. A. WEST, B.SC., A.R.C.S., F.I.C.

*Answers to typical Questions set at the Board of Education Examinations.*

**1. What experimental proof is there of the validity of the formula CO for carbon monoxide?** (1903, St. 2, Th. Inorg. Chem.)

When carbon is burned in excess of oxygen the final volume of gas is the same as the initial volume, although carbon dioxide is formed. Hence we know that carbon dioxide contains its own volume of oxygen, and hence we may write the formula $C_xO_2$. Now the density of carbon dioxide, as compared with that of hydrogen, is shown by experiment to be 22, and since the molecular weight of a gas is numerically equal to twice the density, the molecular weight of carbon dioxide is 44.

This agrees with the above formula if $x=1$, for C = 12 and O = 16, whence $CO_2 = 44$.

If two volumes of carbon monoxide are exploded in an eudiometer with two volumes of oxygen, the resulting mixture measures three volumes. On absorbing the carbon monoxide formed by means of potash one volume of oxygen remains, showing that two volumes of carbon monoxide have combined with one volume of oxygen to form two volumes of carbon dioxide. If the formula of carbon dioxide is $CO_2$, as shown above, then the formula of carbon monoxide will be CO, and the reaction will be represented by the equation

$$2CO + O_2 = 2CO_2.$$

Now if the formula CO is correct, the molecular weight of the gas will be 28 (*i.e.* 12 + 16), and the density 14. Experimentally determined the density is found to be 14, that of hydrogen being taken as 1. Hence the formula CO is correct.

**2. Which of the following gases are lighter and which heavier than air: Oxygen, carbon monoxide, marsh gas, ammonia, sulphur dioxide, hydrogen sulphide?**

**Calculate the weight of 10 litres of carbon dioxide at normal temperature and pressure.** (1903, St. 2, Th. Inorg. Chem.)

Taking the density of hydrogen at normal temperature and pressure as unity, the density of air under the same conditions is 14·4. The densities of the following gases as deduced from their chemical formulæ are:—

| Gas. | Formula. | Molecular Weight. | Density. |
|---|---|---|---|
| Oxygen . . . . | $O_2$ | 32 | 16 |
| Carbon monoxide . . | CO | 28 | 14 |
| Marsh gas . . . . | $CH_4$ | 16 | 8 |
| Ammonia . . . . | $NH_3$ | 17 | 8·5 |
| Sulphur dioxide . . . | $SO_2$ | 64 | 32 |
| Hydrogen sulphide . . | $H_2S$ | 34 | 17 |

It will thus be seen that marsh gas, ammonia, and carbon monoxide are lighter than air, but oxygen, hydrogen sulphide and sulphur dioxide are heavier than air.

The formula of carbon dioxide is $CO_2$, and its molecular weight 44. Its density is therefore 22. Now 1 litre of hydrogen under normal temperature and pressure weighs 0·0896 grams, and therefore 1 litre of carbon dioxide weighs $0{\cdot}0896 \times 22$ grams, and 10 litres weigh $0{\cdot}0896 \times 22 \times 10$ grams = 19·712 grams.

**3. Arrange the following substances into two groups—(*a*) Oxidising Agents, and (*b*) Reducing Agents: Chlorine, nitric acid, chromic acid, sulphurous acid, nitrous acid, hydrogen sulphide.**

**Explain by an equation the action of any one of the oxidising group on a solution of ferrous sulphate, and the action of one of the reducing agents on a solution of ferric chloride.** (1903, St. 2, Th. Inorg. Chem.)

(*a*) Oxidising Agents.—Chlorine, nitric acid, chromic acid.
(*b*) Reducing Agents.—Sulphurous acid, nitrous acid, hydrogen sulphide.

Chlorine acts on a solution of ferrous sulphate as an oxidising agent in the manner indicated by the following equation:—

$$6FeSO_4 + 3Cl_2 = 2Fe_2(SO_4)_3 + 2FeCl_3.$$

If dilute sulphuric acid is present in excess, then the reaction is

$$6FeSO_4 + 3H_2SO_4 + 3Cl_2 = 3Fe_2(SO_4)_3 + 6HCl.$$

Hydrogen sulphide acts on a solution of ferric chloride as a reducing agent according to the following equation:—

$$2FeCl_3 + H_2S = 2FeCl_2 + 2HCl + S,$$

sulphur being precipitated.

**4. Describe and explain fully the ferrous sulphate test for nitrates.** (1904, St. 2, Pract. Inorg. Chem. Written examination.)

The solution to be tested for nitrate is mixed with strong sulphuric acid in a test tube, the mixture being kept cold. A solution of ferrous sulphate is then gently poured down the side of the test tube so that it does not mix with but lies as a distinct layer on top of the mixture. If a nitrate is present in the original solution, nitric acid is liberated by the sulphuric acid.

When the nitric acid comes in contact with the ferrous sulphate solution it is reduced to nitric oxide, and this tending to rise is dissolved in the ferrous sulphate solution, producing the brown colour which a solution of nitric oxide in ferrous sulphate always shows. If the solution is heated the nitric oxide is expelled and the brown colour disappears. The production of nitric oxide from the liberated nitric acid by the ferrous sulphate is shown by the following equation:—

$$2HNO_3 + 6FeSO_4 + 3H_2SO_4 = 2NO + 3Fe_2(SO_4)_3 + 4H_2O.$$

**5. Write equations expressing the action of hydrochloric acid on aqueous solutions of silver, lead, and mercurous nitrates, and the action of ammonia on the resulting precipitate in each case.** (1904, St. 2, Pract. Inorg. Chem. Written examination.)

Action of hydrochloric acid on

(*a*) Silver nitrate.

$$AgNO_3 + HCl = AgCl + HNO_3.$$
(white pp.)

(*b*) Lead nitrate.

$$Pb(NO_3)_2 + 2HCl = PbCl_2 + 2HNO_3.$$
(white pp.)

(*c*) Mercurous nitrate.

$$Hg_2(NO_3)_2 + 2HCl = Hg_2Cl_2 + 2HNO_3.$$
(white pp.)

Action of ammonia on the resulting precipitates—

(*a*) Silver chloride.

$$2AgCl + 3NH_4OH = 2AgCl,3NH_3 + 3H_2O.$$

The silver chloride is converted into soluble $2AgCl,3NH_3$, giving a colourless solution.

(*b*) Lead chloride.

$$PbCl_2 + NH_4OH = PbHOCl + NH_4Cl.$$

The ammonia partially or wholly converts the lead chloride into PbHOCl (lead chlorohydrate), a white powder almost insoluble in water.

(*c*) Mercurous chloride.

$$Hg_2Cl_2 + 2NH_4OH = NH_2Hg_2Cl + NH_4Cl + 2H_2O.$$

The white mercurous chloride is converted into a black compound $NH_2Hg_2Cl$, almost insoluble in water.

**6. Describe the chief properties of one of the following elements and its most important compounds, and indicate its relation to other elements: thallium, tungsten, manganese.** (1903, Hons., Pt. I., Th. Inorg. Chem.)

*Thallium.*—Thallium is a metal very similar to lead in some of its properties, and in others very similar to potassium.

It is extracted from the flue dust of sulphuric acid works when the ore used contains it. The dust is treated with sulphuric acid when the metal passes into solution as the sulphate $Tl_2SO_4$.

The substance is then precipitated by means of hydrochloric acid as the chloride TlCl. This is further purified by dissolving in hot sulphuric acid, diluting and saturating with sulphuretted hydrogen to remove arsenic, antimony, silver, &c. The solution is filtered and ammonia added to precipitate any aluminium and iron. The filtrate yields thallous sulphate crystals on evaporation. A solution of thallous sulphate when electrolysed yields metallic thallium.

The metal may also be prepared by acting on a solution of a salt of thallium with zinc. The metal exhibits at a freshly cut surface a silvery lustre with a bluish white tint. It appears very much like lead but tarnishes much more quickly, the black thallous oxide forming on the surface. It is a heavy metal of specific gravity, 11·8. It melts at 290° C. Like lead it is malleable, and to a certain extent ductile. Like potassium it is oxidised in air, but not so readily. In moist air or in water open to the air it is slowly converted into the hydroxide, which is soluble in water, giving a strongly alkaline solution. When heated in presence of air it is rapidly converted into thallic oxide, $Tl_2O_3$. It burns in chlorine, forming TlCl, and it dissolves readily in acids.

Thallium forms two series of well-defined salts—thallous salts, in which the metal acts as a monad; and thallic salts, in which it apparently acts as a triad.

The following are some of the more important of its compounds:—

*Thallous oxide* ($Tl_2O$), a black powder formed by heating the hydroxide in a steam bath.

*Thallic oxide* ($Tl_2O_3$), a dark reddish powder formed by burning thallium in oxygen. It is insoluble in water. With warm dilute sulphuric acid it gives thallic sulphate—

$$Tl_2O_3 + 3\,H_2SO_4 = Tl_2(SO_4)_3 + 3H_2O.$$

*Thallous sulphide* ($Tl_2S$) is formed as a black precipitate when sulphuretted hydrogen is passed through a neutral or alkaline solution of a thallous salt. It may also be formed in presence of acetic acid, but not of strong acids.

*Thallic sulphide* ($Tl_2S_3$) can be formed as a black mass by heating the metal with excess of sulphur.

*Thallous chloride* (TlCl) is formed when thallium is burned in chlorine or by precipitating a solution of a thallous salt with hydrochloric acid. It is a white substance which is turned violet by sunlight. When suspended in water and acted on by chlorine it yields thallic chloride, $TlCl_3$. Just in the same way as the chlorides of potassium, rubidium, &c., it forms a double chloride with platinic chloride which is practically insoluble in water.

*Thallous sulphate* ($Tl_2SO_4$) is formed when thallium is dissolved in dilute sulphuric acid. It is isomorphous with potassium sulphate, and like it forms an alum, $Tl_2SO_4$, $Al_2(SO_4)_3$, $24H_2O$. In this alum the thallium sulphate replaces potassium sulphate, but thallic sulphate, $Tl_2(SO_4)_3$, does not form an alum, as we should have expected from the position of thallium in the periodic table. Thallium belongs to the aluminium group and acts as a triad in many compounds, but it resembles lead in that it gives an almost insoluble chloride, iodide and bromide, and a black sulphide.

The sulphide, however, is much more soluble in mineral acids than lead sulphide. It resembles potassium in the solubility of its oxide, hydrate, carbonate, and sulphate in water, the isomorphism of its sulphate, perchlorate, and phosphate with the corresponding salts of potassium, in the formation of an alum and a double chloride with platinic chloride.

**7. Describe briefly the properties of the oxides and chlorides of phosphorus and the action of water upon each.** (1901, Adv. Th. Inorg. Chem.)

The oxides and chlorides of phosphorus are:—

Phosphorus pentoxide.
Phosphorus trioxide.
The so-called phosphorus tetroxide.
Phosphorus trichloride.
Phosphorus pentachloride.

*Phosphorus Pentoxide* ($P_2O_5$) is a white voluminous amorphous powder as ordinarily prepared. When pure it is without smell. The commercial oxide has a faint garlic odour, but this is due to the presence of a small quantity of phosphorous oxide. It is very hygroscopic, and is therefore used as a drying agent for removing moisture from gases, &c. It is, in fact, the most useful desiccating agent we possess. When dropped into water it dissolves rapidly, and a hissing sound is produced, due to the formation of steam by the heat generated by the vigorous chemical action. As a result of the reaction metaphosphoric acid is produced.

$$P_2O_5 + H_2O = 2HPO_3.$$

The metaphosphoric acid gradually changes to orthophosphoric acid.

$$HPO_3 + H_2O = H_3PO_4.$$

So great is the affinity of this oxide for water that it abstracts the elements of water from many organic and inorganic substances.

*Phosphorus Trioxide* is a snow-white crystalline solid which melts at 22·5° C. to a colourless liquid. At 21° C. it solidifies again to a white mass having the appearance of white wax. It crystallises in monoclinic prisms. It boils at 173·1° C., and its vapour density shows that its molecular weight is 221·52 and its formula $P_4O_6$.

In *cold* water it gradually dissolves, forming phosphorous acid.

$$P_4O_6 + 6H_2O = 4H_3PO_3.$$

In *hot* water a violent reaction takes place, phosphoretted hydrogen is evolved and takes fire spontaneously, and a red deposit is formed, the composition of which is unknown but which probably contains red phosphorus, with possibly an oxide which has not yet been fully investigated.

When phosphorus trioxide is exposed to air it very slowly oxidises to the pentoxide, which of course absorbs moisture if the air is moist. If warmed in oxygen or placed in chlorine it burns spontaneously.

*Phosphorus Tetroxide.*—This oxide is formed when the trioxide is heated in a sealed tube to between 300° and 400° for some days. Phosphorus is formed at the same time.

$$2P_4O_6 = 3P_2O_4 + 2P.$$

The phosphorus and the tetroxide can be separated by fractional distillation in a vacuum. The oxide forms clear crystals, which are not very rapidly oxidised in cold air. If heated, however, they burn to form the pentoxide. The oxide is hygroscopic, taking up moisture from the air. It dissolves in water, apparently forming a mixture of phosphoric and phosphorous acid.

$$P_2O_4 + 3H_2O = H_3PO_3 + H_3PO_4.$$

The molecular formula as shown by the vapour density is much more complex than is represented by the formula $P_2O_4$.

*Phosphorus Trichloride* is a colourless liquid boiling at 76° C. As usually prepared by passing dry chlorine over warm red phosphorus it contains phosphorus pentachloride, but it can be purified by distillation over ordinary phosphorus. It fumes strongly in moist air and is decomposed by water into hydrochloric and phosphorous acids.

$$PCl_3 + 3H_2O = H_3PO_3 + 3HCl.$$

*Phosphorus Pentachloride* is a crystalline solid of a very pale yellow colour, giving off a pungent odour. In moist air it fumes strongly, hydrochloric acid and phosphorus oxychloride being formed.

$$PCl_5 + H_2O = 2HCl + POCl_3.$$

Like phosphorus oxychloride it yields hydrochloric and phosphoric acids with excess of water.

$$PCl_5 + 4H_2O = H_3PO_4 + 5HCl.$$
$$POCl_3 + 3H_2O = H_3PO_4 + 3HCl.$$

Under considerable pressure it melts at about 148° C., but under ordinary pressure it sublimes below 100° C. without melting. The pentachloride is largely used in connection with organic chemistry for replacing the group OH by chlorine thus—

$$\begin{matrix}CH_3\\OH\end{matrix} > CO + PCl_5 = \begin{matrix}CH_3\\Cl\end{matrix} > CO + POCl_3 + HCl.$$

$$\begin{matrix}CH_3\\OH\end{matrix} > CH_2 + PCl_5 = \begin{matrix}CH_3\\Cl\end{matrix} > CH_2 + POCl_3 + HCl.$$

**8. Describe the effect of adding a solution of caustic potash, first in moderate quantity, then in excess, to solutions of the following salts—(*a*) Zinc sulphate, (*b*) mercuric chloride, (c) ferric chloride, (*d*) chromic sulphate.** (1901, St. 2, Pr. Inorg. Chem., Written Exam.)

When caustic potash is added to the solutions named in the question, the following reactions occur :—

(*a*) With zinc sulphate zinc hydrate is first precipitated.

$$ZnSO_4 + 2KOH = Zn(OH)_2 + K_2SO_4.$$

With excess of potash the zinc hydrate dissolves to potassium zincate.

$$Zn(OH)_2 + 2KOH = Zn\,OK)_2 + 2H_2O.$$

(*b*) With mercuric chloride a precipitate is formed which is at first light-coloured but soon becomes yellow, and becomes reddish yellow on heating. The precipitate is mercuric hydrate, $Hg(OH)_2$, and this is insoluble in excess of potash.

(*c*) With ferric chloride brownish red ferric hydrate is produced, and this is insoluble in excess.

$$FeCl_3 + 3KOH = Fe(OH)_3 + 3KCl.$$

(*d*) With chromic sulphate a green precipitate of chromic hydrate is formed.

$$Cr_2(SO_4)_3 + 6KOH = 2Cr(OH)_3 + 3K_2SO_4.$$

The chromic hydrate dissolves readily in excess of the reagent to a green solution. When the solution is heated, chromic hydrate begins to separare out, but long continued heating is required to complete the precipitation.

## PHYSIOGRAPHY.

### (STAGES 2 AND 3.)

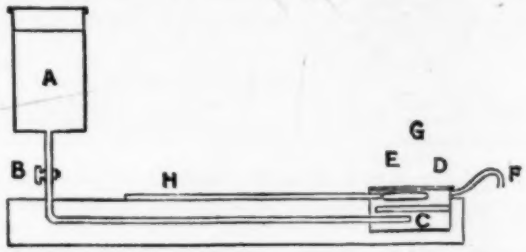
**1. Describe what is meant by "Dew-point," and explain a method by which it may be determined.** (1903, St. 2.)

The atmosphere always contains moisture. The amount of moisture which a given quantity of air will hold depends upon the temperature. When the air at any temperature contains as much moisture as it is able to hold at that temperature it is said to be saturated. If the temperature of the air is reduced it will not hold so much moisture as it will at a higher temperature, consequently, if the air is first saturated and we then reduce its temperature, some of the water-vapour will be deposited on the cold bodies in contact with the air. The moisture thus deposited collects in small globules and is spoken of as dew. If we take air at a given temperature containing moisture in quantity insufficient to saturate it and we reduce its temperature, we shall come to a temperature at which the moisture already in the air will then be sufficient to saturate it. At this temperature dew begins to form, and this temperature is known as the dew-point.

The dew-point may be determined by cooling the air locally and noting the temperature at which dew commences to be deposited. This is conveniently done by means of Daniell's hygrometer, Dine's hygrometer, or Regnault's hygrometer.

Dine's hygrometer is shown in section in the sketch. A is a vessel containing water cooled by ice, B is a stopcock on a metal pipe by means of which water is allowed to flow from A into the vessel C. In C is a baffle plate D, which causes the cold water to flow over the bulb of the horizontal thermometer HE. The water then flows out by the pipe F.

Above the bulb of the thermometer is a black glass plate, or in some instruments a thin sheet of polished silver. The cold water in contact with the thermometer bulb and the black glass




reduces their temperatures to the same extent. When the glass G has become sufficiently cooled, dew is deposited on it. The flow of water is stopped by turning B, and the temperature of the water in C then begins to rise, and the dew gradually disappears. The temperatures when the dew first begins to form, and when it disappears, are read, and the mean taken as the dew-point. Several other determinations are made, and the mean taken so as to get as accurate a value as possible.

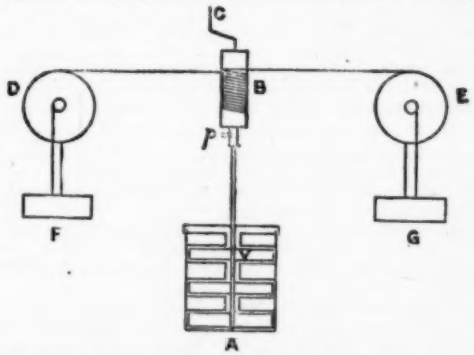
**2. What is meant by the mechanical equivalent of heat?**

**Describe Joule's fluid-friction method of measurement, and state the result obtained.** (1903, Adv.)

If we take a piece of metal, say a metal button, and rub it vigorously on a piece of wood, we find that the metal becomes quite hot. The heat is produced by the work done in overcoming the friction between the two bodies. The amount of heat produced depends on the amount of work done, and it has been proved by Dr. Joule and others that when heat is produced by the expenditure of energy or when heat is utilised for doing work, the work and energy are directly proportional to each other. By means of the apparatus described below, Joule determined the amount of energy which must be expended to produce one unit of heat, and this amount is known as the mechanical equivalent of heat. This quantity is generally represented by J, the first letter of Joule's name.

The apparatus employed by Joule for his experiment is shown diagramatically in the sketch. A is a calorimeter with vanes attached to the side, V is a spindle with vanes which can just pass between the vanes on the walls of the vessel. The spindle is rotated by means of falling weights F and G.

The weights are attached to strings wound on the axles of the wheels D and E. Strings attached to the circumferences of these wheels pass in opposite directions round the drum B on the spindle carrying the vanes. B is connected to this spindle




by a pin *p*. A handle C is provided for turning the spindle and raising the weights. The method of working was as follows: The weights were wound up as high as possible, and the temperature of the water in A taken by a very sensitive thermometer. (Joule's thermometer read to $\frac{1}{100}$° C.)

The weights were then allowed to fall, and the spindle with the vanes churned up the water in the calorimeter.

The energy imparted to the water of course finally appeared as heat, and the temperature rose. The pin *p* was then withdrawn, and the weights wound up without disturbing the water. The pin was again inserted, and the weights allowed to fall. This was repeated about twenty times, and the temperature again taken.

# CLOUGH'S
# Correspondence College,

*The Oldest and Most Successful Correspondence College*

**Temple Chambers, London, E.C.**

## KING'S SCHOLARSHIP EXAMINATION, December 1904.

### Remarkable Successes of Clough's Scholarship Students.

**Miss BEATRICE L. MAJOR, 157 South Street, Bridport, Dorset,**

A Student of Clough's Scholarship Class for December 1904, is placed in

**DIVISION I. OF THE FIRST CLASS.**

She therefore wins a

**PRIZE OF £100**

as promised in Clough's Scholarship Prospectus.

**Mr. LEONARD COUCH, 13 Ranelagh Road, St. Austell, Cornwall,**
**Mr. ALFRED DAVISON, 27 Nuncar Road, Kirkby, Notts,**
**Mr. CUTHBERT J. MOGFORD, Ivy Lodge, Westbury-on-Trym,**
**Mr. HARRY SLOMAN, 14 Castle Street, Tiverton, Devon,**

all Students of Clough's Scholarship Class for December 1904, are placed in

**DIVISION I. OF THE FIRST CLASS**

and the

**PRIZE OF £100**

is therefore equally divided among these four Students as promised in Clough's Scholarship Prospectus.

Other successful Students of the **DECEMBER 1904** Class include:—

**Mr. T. Atlay,** 87 Nora Street, Chester Road, Sunderland.
**Mr. H. F. Atwill,** Blue Coat School, Great Torrington.
**Mr. H. H. Coram,** 108 Kennington Avenue, Bishopston, Bristol.
**Mr. O. L. Hill,** 10 Belle Vue, Clifton.
**Mr. P. Kerslake,** 23 East Avenue, East Ham.
**Mr. F. J. Lewendon,** 8 Runnacleave Crescent, Ilfracombe.
**Mr. Martin J. Manning,** West Town, Backwell, Bristol.
**Mr. J. Marsh,** The Ashgrove, Swanwick, Alfreton.
**Mr. A. Ogden,** 62 Lomeshaye Road, Nelson, Lancs.
**Mr. A. W. Pegrum,** 6 Newcomen Road, Tunbridge Wells.
**Mr. W. L. Upham,** 3 Eastover, Bridgwater.
**Miss E. F. Barker,** Higher Grade Girls' School, Eden Street, Cambridge.
**Miss M. J. Davey,** 15 Sandfield Terrace, Guildford.
**Miss G. E. Howse,** Church Road, Blaenavon, Mon.
**Miss M. A. Hulls,** 2 Southwell Terrace, New Holland.
**Miss L. G. Kettle,** 7 Elm Terrace, Bourne, Lincs.
**Miss L. H. Musker,** 14 Clovelly Road, Anfield, Liverpool.
**Miss O. Powell,** 2 Belvedere Terrace, Buxton.
**Miss E. M. Savage,** 133 Station Street, Derby Road, Loughborough.
**Miss E. L. Watts,** 395 Fishponds Road, Ridgeway, Bristol.

All of whom are placed in **DIVISION II. OF THE FIRST CLASS,**

**Besides 40 Students in Division III. of the First Class and over 150 other Successes in the First Class.**

☞ *TO SECURE ADMISSION TO CLOUGH'S SCHOLARSHIP CLASS IMMEDIATE APPLICATION IS NECESSARY.*

***For Prospectus, Plan, Terms, Entry Form, &c., application should be made to—***

**THE SECRETARY,**
**Clough's Correspondence College,**
**Temple Chambers, London, E.C.**

The work done by the weights was ascertained in foot-pounds by multiplying together the weight in pounds, the distance fallen through in feet, and the number of times the weights fell. The amount of heat produced was found by multiplying the weight of water in pounds plus the water equivalent of the calorimeter by the rise in temperature (in degrees Fahrenheit). Joule was then able to calculate how many foot-pounds of work were required to produce enough heat to raise the temperature of one pound of water through one degree Fahrenheit. This he found to be 772 foot-pounds. This, then, was Joule's figure for the mechanical equivalent of heat, expressed in English units.

Numerous corrections were applied by Joule in order to get a trustworthy result. Corrections were made for the heat lost from the calorimeter by radiation, the velocity of the weights when they reached the floor, the stretching of the cords, the friction of the pulleys, and the energy lost by vibrations.

**3. How has it been proved that white light is complex? Demonstrate that the light of any one colour cannot be further broken up.** (St. 2, 1904.)

Sir Isaac Newton investigated the colours produced from white light by means of a prism. He allowed sunlight to pass through a small hole in the shutter of a dark room, and allowed it to pass through a glass prism. The band of light after emerging from the prism was allowed to fall on to a white screen, and instead of white light a band of various colours was seen, the colours being the same as those seen in the rainbow. This was taken as evidence that white light was composite in character, being composed of light of all the colours of the rainbow. In order to confirm the conclusion arrived at, the light emerging from the prism was next caused to pass through an exactly similar prism in contact with the first, but reversed so that the bases of the prisms faced in opposite directions. The second prism caused practically all the colour to disappear and reproduced white light.

White light can be split up into its constituents and thus proved to be complex by interference apparatus such as Newton's ring apparatus and the diffraction grating.

The view that light of one colour cannot be further broken up is supported by experiments such as the following: Take the coloured light emerging from the prism, as described in Newton's experiment above, and receive it on a screen. Make a small hole in the screen and let light of one colour pass through and fall on a second prism. It will be found that the light is still all of one colour after leaving the prism. In no way does it seem possible to break up a simple spectrum colour so as to get other colours from it.

**4. Describe the characters presented by scoriæ, pumice, volcanic bombs and volcanic dust, explaining how each is formed.** (St. 2, 1904.)

*Scoriæ* are practically volcanic cinders, consisting of rock which has been rendered porous and spongy while in a viscid condition by means of steam and other gases. It is really a cellular lava. Usually scoriæ are formed by masses of lava being thrown into the air from volcanic vents, the gases escaping at the same time and leaving the mass spongy.

*Pumice* occurs in large quantities, and consists of a porous lava. It occurs most abundantly on the upper and lower faces of lava streams, being formed by the disengagement of gases during the time it was solidifying.

*Volcanic bombs* are round or fusiform masses of lava, sometimes distended by gas. They have been formed by masses of molten or viscid rock being thrown into the air from volcanoes. The round shape is due to the rotation to which they have been subjected while travelling through the air and solidifying.

*Volcanic dust* is the very fine powder which is formed during a volcanic eruption. It is sometimes exceedingly fine, and this is due to the large amount of attrition to which it has been subjected while in the air. Some of the particles are so fine that they will remain in the air sufficiently long to be carried by it hundreds of miles.

**5. Give an account of the discovery of Neptune. State what is known about this planet.** (St. 2, 1903.)

Every planet in the solar system has a gravitational effect upon the motion of every other member. After the discovery of Uranus in 1781 by Sir William Herschel, it was found that there was something peculiar in its motions which could only be accounted for by the supposition that it was acted on gravitationally by some other planet as yet unknown. If, as seemed almost certain, the existence of such a planet was the true explanation of the observed peculiarities in the motion of Uranus, it was soon seen that the unknown planet must be at a greater distance from the sun than Uranus itself. As years went on, and the records of the results of the observations on Uranus accumulated, it was found possible to calculate with a certain degree of certainty the position of the still unknown planet. This calculation was undertaken independently by Professor Adams and M. Leverrier. In July 1846, the search for the planet was commenced with a large telescope at Cambridge, in the portion of the heavens indicated by the results of Professor Adams' calculations. In September of the same year M. Leverrier wrote to the Berlin Observatory giving the results of his calculations. His result was almost identical with that obtained by Professor Adams, the position indicated by the two being less than a degree apart. Dr. Galle, the same evening, by aid of the star maps, was successful in discovering the new planet, which is now known as Neptune. It was found very close to the position calculated by the two astronomers.

The distance of Neptune from the sun is roughly 2,794,000,000 miles, or thirty times the distance of the earth. Its diameter is more than four times the diameter of the earth, being approximately 34,500 miles.

Neptune has one satellite, which, like the satellites of Uranus, revolves round the planet in a direction from east to west, or in the opposite direction to the movements of the satellites of other planets of the solar system. The mass of Neptune is about seventeen times that of the earth, but its mean density is only about one-fifth that of the earth, or nearly the same as the density of water.

Neptune travels round the sun once in 60,181 days, or a little over 163 years.

**6. Compare the spectra of stars and nebulæ and state briefly the information which the spectroscope affords as to the physical and chemical condition of these bodies.** (Hons., 1903).

The spectrum of the sun consists of a bright band of colour with a large number of dark lines across it. This appearance is due to the main body of the sun consisting of solid or liquid particles at a high temperature and giving out white light. This light before it leaves the sun has to pass through the sun's atmosphere, which consists of the vapours of some of the elements which compose the body of the sun. Now when white light travels through a gas some of the light is absorbed or suppressed, and the rays absorbed are just those which the gas would give out of itself if it were raised to incandescence. By comparing these absorption lines in the sun's spectrum with those given by certain metals at high temperatures (in the electric spark gap) we can prove that the sun's atmosphere contains a large number of the elements found in meteorites and on the earth.

If an element is in the gaseous state and raised to incandescence we find that it does not give a bright band of light as the sun does, but it gives a spectrum consisting of a number of bright lines separated by dark spaces. When we come to examine the spectra of the stars we find that many of them present appearances similar to those presented by the sun, while the spectra of the nebulæ consist generally of bright line spectra. In the spectra of the nebulæ the most prominent lines are usually those of magnesium and hydrogen. It would appear from the observations which have been made that spectra of almost all kinds are found amongst those given by the various stars and nebulæ, and that there is no very sharp line to be drawn between stars and nebulæ, one class passing gradually into the other. In one class of nebulæ, as we have already stated, the lines are chiefly those of hydrogen and magnesium. Then we pass through gradual variations to a class of stars in which we have both absorption and radiation, the light being due chiefly to carbon vapour and the absorption to vapours of iron, magnesium, manganese, barium, lead, &c. We then pass to other star spectra in which the light approaches more nearly the condition of the sun, where we get a spectrum with dark absorption lines due largely to vapours of known metals. Then we come to star spectra in which we have absorption lines due chiefly to carbon. From the observations made we readily come to the conclusion that in the case of nebulæ we have swarms of meteorites, and they are luminous because of the heat produced by the numerous collisions amongst the meteorites.

When the heat generated is not sufficiently intense to give rise to incandescent vapours we get a spectrum which is nearly continuous. When the temperature is sufficiently high gases are formed in an incandescent state, and this is rendered evident by the bright line spectra observed.

Thus by means of the spectra observed we are able to deduce much information regarding the physical and chemical conditions prevailing in the nebulæ and stars.

# These Figures Speak for Themselves

In the last **King's Scholarship Examination (1904), Fifty-six** were successful in gaining place in the First Division, First Class. Of these

# Fifty-Three used Professor Meiklejohn's Series

## Thirty-one used

**THE ENGLISH LANGUAGE: Its Grammar, History, and Literature.** By J. M. D. MEIKLEJOHN, M.A. **Twenty-sixth Edition. Enlarged, with Exercises and Additional Analysis.** Crown 8vo, 486 pp. **4s. 6d.**

"I know of no book generally so suitable for an ordinary student."—**Alfred Barriball, Esq., B.A.**, Westminster Training College.

## Twenty-nine used

**A NEW GEOGRAPHY ON THE COMPARATIVE METHOD.** With Maps and Diagrams and an Outline of Commercial Geography. By J. M. D. MEIKLEJOHN, M.A. **Thirty-third Edition (Revised).** Crown 8vo, 630 pp. **4s. 6d.**

"It appears to me to be admirably suited for teachers and advanced scholars. It is full of matter, and the matter could not be more effectively arranged."—**James Ogilvie, Esq., M.A.**, Principal, The Church of Scotland Training College, Aberdeen.

## Twenty-nine used

**A NEW HISTORY OF ENGLAND AND GREAT BRITAIN.** With Maps and Tables. By J. M. D. MEIKLEJOHN, M.A. **Twentieth Edition.** Crown 8vo, 740 pp. **4s. 6d.**

"Your books are simply indispensable to students preparing for the Certificate Examination and to pupil teachers."—**One of His Majesty's Inspectors.**

## Twenty-two used

**A NEW ARITHMETIC. Theoretical and Practical.** By G. A. CHRISTIAN, B.A. (Lond.), Head Master of the Battersea Pupil Teachers' School, and G. COLLAR, B.A., B.Sc. (Lond.), Head Master of the Stockwell Pupil Teachers' School. **Eleventh Edition.** Crown 8vo, 552 pp. **4s. 6d.**

"It is not too much to prophesy that this reliable exposition of the principles of Arithmetic and carefully collated examples will become the leading text-book for P.T. Centres, Schools, and Colleges."—**The Pupil Teacher and Scholarship Student.**

## Ten used

**THE BRITISH EMPIRE: Its Geography, Resources, Commerce, Landways, and Waterways.** By J. M. D. MEIKLEJOHN, M.A. **Seventh Edition (Revised).** Crown 8vo, 350 pp. **8s.**

"This is a book which was due to the student, and which he or she will welcome with deserved praise. The usual 'book on the Colonies' is heavy, dull, ill-arranged; this book is the perfection of arrangement."—**The Teachers' Aid.**

## Nine used

**THE COMPARATIVE ATLAS.** By J. G. BARTHOLOMEW, F.R.G.S., and Edited by Professor MEIKLEJOHN. **New and Improved Edition.** Containing 64 Plates, Map Drawing, Geographical Etymology, and a General Index. **2s. 6d.**

"No atlas that we know at anything like the price gives so much so well."—**The Teachers' Monthly.**

## JUST PUBLISHED. SPECIALLY SUITABLE FOR SCHOLARSHIP STUDENTS

**COMPOSITION FOR SCHOOLS AND COLLEGES, BASED ON OUTLINE ESSAYS.** With Exercises on Style. By C. H. MAXWELL, B.A. Crown 8vo, 144 pp. **1s.**

**TEST QUESTIONS IN HISTORY.** Selected from Examination Papers and Arranged by A. T. FLUX, Inter. B.A. 82 pp. **1s.**

**TEST QUESTIONS IN GEOGRAPHY.** By A. T. FLUX, Inter. B.A. **1s.**

"These questions are intended to serve as a guide and as a test to the student: as a guide as indicating the topics considered most important by examiners; and as a test whereby the student can ascertain whether his reading has been definite and thorough, and whether any important points have been omitted in preparation."

*SEND FOR COMPLETE CATALOGUE*

**MEIKLEJOHN & HOLDEN, 11 PATERNOSTER SQUARE, E.C.**

# THEORETICAL MECHANICS.

## Stage 2.

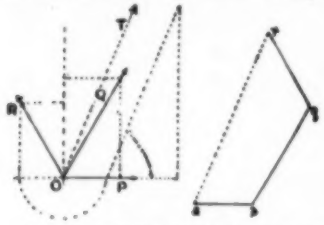
BY FRANK CASTLE, M.I.M.E.,

*Royal College of Science; Lecturer on Mechanics, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.*

The following questions are primarily intended for those readers who intend to take the Examinations of the Board of Education in Theoretical Mechanics, Solids and Fluids. The solutions are given in all cases.

It will be advisable to work out the numerical parts quite independently, referring to the solutions only when necessary to do so.

**Ex. 1.** OP, OQ, OR are the directions of three forces, and the angles POQ and QOR are 60° each; the forces contain 10, 20, and 15 units respectively; find by construction the line OT along which the resultant acts, and note the number of units in the resultant, and the number of degrees in the angle POT.




Make the angles POQ QOR each 60°. At any point *a* draw *ap* parallel to OP and equal to 10 units, *pq* parallel to OQ = 20, and *qr* parallel to OR = 15 units, the resultant is given in direction and magnitude by the line *ar*; *ar* will be found to be 32·8, and the angle *par* = 67° 35′.

Another method would be to make OP = 10, OQ = 20, and OR = 15 units; obtain the horizontal and vertical components, then the right-angled triangle (shown in dotted lines) is obtained, the magnitude and direction of the resultant is obviously the same as before.

By calculation $X = 10 + 20 \cos 60° - 15 \cos 60° = 12{\cdot}5$.

$$Y = 20 \sin 60° + 15 \sin 60° = 30{\cdot}31.$$

$$R = \sqrt{30{\cdot}31^2 + 12{\cdot}5^2} = 32{\cdot}78; \tan\theta = \frac{Y}{X} = \frac{30{\cdot}31}{12{\cdot}5} = 2{\cdot}424,$$

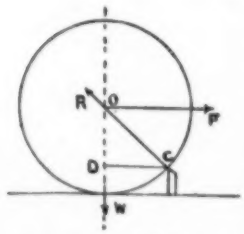
$$\therefore \theta = 67° 35'.$$

**Ex. 2.** (*a*) State and prove the rule for finding the resultant of two unlike parallel forces. (*b*) Given a force of 6 units, show how to resolve it into two unlike parallel forces of which the greater is 10 units, and explain whether the resolution can be made in more ways than one.

(*a*) The rule may be obtained from any text-book on the subject.

(*b*) The resultant of the two given forces will be 10 − 6 = 4 units, and its distance *x* from the force of 6 units may be obtained from the relation $10 \times a = 4x$, where *a* is the distance between the forces 10 and 6.

**Ex. 3.** A carriage wheel of weight W and radius *a* rests upon a level road; show that the force necessary to drag it over an obstacle of height *h* is $\frac{W\sqrt{h\,(2a - h)}}{a - h}$




Find the numerical value of the force when the weight of the wheel is 200 lbs., radius 6 feet, height of obstacle 12 inches.

The three forces acting when the wheel begins to rise are F, W, and the reaction R; of these F and W pass through the centre of the wheel, hence the third force R must also pass through the same point. The three sides of the triangle O C D are parallel to the three forces F W and R respectively, so that if O D represents W, then to the same scale O C represents R and C D = F,

$$\therefore \frac{F}{W} = \frac{D\,C}{O\,D}, \text{ but from the right-angled triangle O D C,}$$

$$D\,C = \sqrt{O\,C^2 - O\,D^2} = \sqrt{a^2 - (a^2 - h^2)};$$

also $$O\,D = a - h,$$

$$\therefore \frac{F}{W} = \frac{\sqrt{a^2 - (a^2 - h^2)}}{a - h}$$

$$\therefore F = \frac{\sqrt{h\,(2a - h)}}{a - h}\,W,$$

substituting the given values

$$F = \frac{\sqrt{1\,(12 - 1)}}{6 - 1} \times 200 = \underline{40\sqrt{11}\text{ lbs.}}$$

**Ex. 4.** Being given the centres of mass of a body and of a particular part of it, find that of the remaining part.

A circular disc of metal 2 feet 3 inches in diameter has a circular hole 3 inches diameter punched in it as near the edge as possible. Find both by construction and calculation the distance of its centre of mass from the centre of the plate.

Let AB represent an edge view of the disc. The mass of the disc or any portion of it would be the product of the volume, and the mass of unit volume.

Let *t* denote the thickness of the disc and *m* the mass of unit volume.

Then the mass of the disc $= \frac{\pi}{4} \times 27^2 \times tm = R.$

The mass of the portion punched out will in like manner be

$$\frac{\pi}{4} \times 3^2 \times tm = Q.$$

Taking moments about O the centre of the disc, then

$$Px = 12Q.$$

Where *x* is the distance of P from O.

Also $$P = \frac{\pi}{4} tm\,(27^2 - 3^2) = \frac{\pi}{4} tm \times 30 \times 24,$$

$$\therefore \left(\frac{\pi}{4} tm \times 30 \times 24\right) x = 12 \times \frac{\pi}{4} \times 9tm,$$

$$\text{or} \qquad x = \frac{12 \times 9}{30 \times 24} = \frac{3}{20} \text{ inch.}$$

**Ex. 5.** What is the relation between the acceleration of the velocity of a body of given mass and the force producing the velocity? Express the relation by means of an equation.

(*a*) Find the force which in three seconds will communicate a velocity of 27 feet a second to a mass of 10 tons.

(*b*) The slope of a smooth inclined plane is 1 foot vertical, 3 feet horizontal; find the acceleration of the velocity of a body sliding down it, and the distance described in 5 seconds from rest.

$$(g = 32{\cdot}2, \sqrt{10} = 3{\cdot}16.)$$

The relation is $F = Mf$ where F denotes the force, M the mass of the body, and *f* the acceleration produced.

Multiplying by *t* we obtain $Ft = Mft = Mv$, or, the impulse of a force = momentum generated.

(*a*) Here $t = 3$, $v = 27$, $M = 10 \div 32{\cdot}2$,

$$\therefore F \times 3 = \frac{10 \times 27}{3 \times 32{\cdot}2} = 2{\cdot}795 \text{ tons.}$$

(*b*) The acceleration down the plane is $g \sin \alpha$ where $\alpha$ is the inclination of the plane to the horizon.

$$\sin \alpha = \frac{1}{\sqrt{1^2 + 3^2}} = \frac{1}{\sqrt{10}}$$

$$S = \frac{1}{2} g \sin \alpha t^2 = \frac{g \times 25}{2\sqrt{10}}$$

$$= \frac{32{\cdot}2 \times 25}{2 \times 3{\cdot}16} = \underline{127{\cdot}4 \text{ feet.}}$$

**Ex. 6.** If a body be moving with constant acceleration, show that the magnitude of the acceleration may be determined by timing its passages over two consecutive equal portions of its path.

Telegraph posts being 80 feet apart the times taken by a train in passing consecutive intervals between the posts are found to be 5 and 4 seconds respectively; prove that the acceleration is numerically 8 ÷ 9.

Let S denote the space passed over in a time *t* by a body moving with initial velocity V and constant acceleration *f*, then the relation is given by $S = Vt + \frac{1}{2} ft^2$ . . . . . (1).

If $t_1$ is the time taken to cover the first interval and *f* the acceleration—

# CAMBRIDGE UNIVERSITY PRESS

*NOW READY.*

A NEW TRIGONOMETRY BY PROFESSOR LONEY.

*Intended for the use of Students commencing Trigonometry.*

**THE ELEMENTS OF TRIGONOMETRY.** By S. L. LONEY, M.A., Professor of Mathematics at the Royal Holloway College (University of London), sometime Fellow of Sidney Sussex College, Cambridge. Extra foolscap 8vo, 3s. 6d.

"Altogether an admirable piece of work, and we can pay it no higher compliment than to say that it is well on the level of those other text books for which Professor Loney is so well known."—*Academy.*

"The book is a welcome addition to those really suitable for private students."—*Teachers' Monthly.*

---

**ELEMENTARY GEOMETRY, PRACTICAL AND THEORETICAL.** By C. GODFREY, M.A., Senior Mathematical Master at Winchester College, and A. W. SIDDONS, M.A., Fellow of Jesus College, Cambridge, Assistant-Master at Harrow School. Large crown 8vo, pages xii. to 356.

(1) Complete in One Volume, 3s. 6d.

(2) In Two Volumes: Vol. I. (Experimental Course and Books I. and II.), 2s.; Vol. II. (Books III. and IV.), 2s.

(3) In Five Parts: Part I. (Experimental Geometry), 1s.; Part II. (Theoretical Geometry), Book I., 1s.; Part II. Book II., 1s.; Part II. Book III., 1s.; Part II. Book IV., 1s.

ANSWERS TO THE EXAMPLES, 4d., post free.

This book has been written especially with a view to the New Syllabus of Geometry adopted by the University of Cambridge.

**SOLUTIONS OF THE EXERCISES IN GODFREY AND SIDDONS' ELEMENTARY GEOMETRY.** By E. A. PRICE, B.A., Master at Winchester College. Crown 8vo, 5s. net.

*ENGLISH GRAMMARS.*

**THE ELEMENTS OF ENGLISH GRAMMAR.** By A. S. WEST, M.A., Trinity College, Cambridge. New and Enlarged Edition. Seventieth to Eighty-fifth Thousand. Extra foolscap 8vo, 2s. 6d.

"It is far and away the best of its class hitherto published for boys of thirteen to sixteen years of age, and, if we mistake not, will soon become a standard text in secondary schools, and mark a new epoch in the teaching of English Grammar."—*Guardian.*

**AN ENGLISH GRAMMAR FOR BEGINNERS.** By the same Author. Seventy-sixth to Hundredth Thousand. 1s.

"It is a capital little work which we can heartily recommend."—*Schoolmaster.*

**A KEY TO THE QUESTIONS CONTAINED IN WEST'S ELEMENTS OF ENGLISH GRAMMAR AND ENGLISH GRAMMAR FOR BEGINNERS.** By A. S. WEST, M.A. 3s. 6d. net.

---

*THE CAMBRIDGE SERIES FOR SCHOOLS AND TRAINING COLLEGES.*

General Editor—W. H. WOODWARD, Professor of Education in the University of Liverpool.

**ARISTOTLE ON EDUCATION: being Extracts from the "Ethics and Politics."** Translated and Edited by J. BURNET, Professor of Greek in the United College of St. Salvator and St. Leonard, St. Andrews. Crown 8vo, 2s. 6d.

**THE EDUCATION OF THE YOUNG, in the "Republic" of Plato.** Translated into English, with Notes and Introduction, by B. BOSANQUET, Author of "A Companion to Plato's 'Republic.'" Crown 8vo, 2s. 6d.

**THE MAKING OF CHARACTER: Some Educational Aspects of Ethics.** By JOHN MACCUNN, Balliol College, Oxford, Professor of Philosophy in University College, Liverpool. Crown 8vo, cloth, 2s. 6d.; cloth extra, gilt top, 3s. 6d.

NEW VOLUME.

*Subject for Oxford Local and College of Preceptors' Examinations, 1905.*

**VERGIL.—AENEID, Book III.** Edited, with Introduction, Notes, and Complete Vocabulary, by A. SIDGWICK, M.A., Reader in Greek in the University of Oxford. 1s. 6d.

**A LIST OF NEW AND STANDARD BOOKS FOR SCHOOLS WILL BE SENT ON APPLICATION**

**LONDON: Cambridge University Press Warehouse, Ave Maria Lane: C. F. CLAY, Manager**

# OXFORD UNIVERSITY PRESS

## OXFORD MODERN FRENCH SERIES

Edited by LEON DELBOS, M.A. Crown 8vo, cloth.

*THREE NEW VOLUMES*

**LES NORMANDS EN ANGLETERRE ET EN FRANCE.** By THIERRY. Edited by A. H. SMITH. Pp. 160. 2s. 6d.

**LE SERMENT.** By JULES DAVID. Edited by CECILE HUGON. Pp. 96. 1s. 6d.

**VOYAGE EN ESPAGNE.** By GAUTIER. Edited by GERALD GOODRIDGE. With a Map. Pp. 215. 2s. 6d.

*PREVIOUSLY PUBLISHED.*

**Deux Héroïnes de la Révolution Française.** By LAMARTINE. Edited by MARY BENTINCK-SMITH. Pp. 192. 2s. 6d.

**La Vendetta and Pierre Grassou.** By BALZAC. Edited by MARIE PÉCHINET, B.A. Pp. 140. 2s.

**Bug-Jargal.** By VICTOR HUGO. Edited by LOUIS SERS. Pp. 152. 2s.

**Mademoiselle de la Seiglière.** By SANDEAU. Edited by A. L. DUPUIS. Pp. 214. 2s. 6d.

**Mémoires d'Outre-Tombe.** By CHATEAUBRIAND. Edited by LOUIS SERS. Pp. 164. 2s. 6d.

**Voyage autour de mon Jardin.** By KARR. Edited by STUART G. HALLAM, M.A. Pp. 148. 2s.

**Le Château de Vaux.** By GOZLAN. Edited by A. H. SMITH, M.A. Pp. 92. 1s. 6d.

**Extraits des Voyages d'Alexis de Tocqueville.** Edited by J. MANSION. Pp. 192. 2s.

"Mr. Delbos has made an admirable choice of the works he has laid under contribution. Most of them are additionally interesting from the fact that they deal with notable periods of French history. . . . The volumes are carefully but not unduly annotated; they are well printed and bound."—*Practical Teacher.*

"The variety, the interest, and the excellence of the matter are obvious from the mere enumeration; and the notes deal briefly with points of literary, historical, and geographical importance, some little command of the language being assumed. The paper and type are excellent, and the binding is strong. An excellent and welcome series, most serviceable in the higher classes in schools, and attractive to the general reader of French."—*Educational Times.*

"The books have been exceptionally printed. . . . The editing is well done, and altogether the volumes belong to a better class of text-books, and are certainly to be commended."—*School.*

---

*Complete Catalogue post free on application.*

LONDON: HENRY FROWDE,
Oxford University Press Warehouse, Amen Corner, E.C.

Eighth Edition. With Supplementary Easier Exercises and an Appendix on State Simplification of French Syntax. Fcap. 8vo, cloth, interleaved. Price 1s.

# Hints on French Syntax

By FRANCIS STORR, B.A.Camb.,

*Occasional Inspector to Board of Education, Scotch Board of Education, and Central Welsh Board;*
*Examiner to Oxford and Cambridge Joint Board, Cambridge Higher Locals, Scotch Board of Education, Civil Service Commission, University of London, &c., &c.*

"Mr. Storr's 'Hints' are to the purpose. They are intended for schoolboys, but grown-up people who wish to avoid making elementary blunders in either writing or speaking may use them with advantage."—*The Athenæum.*

"A useful and thoroughly practical little book."—*The Academy.*

"A valuable supplement to any grammar that might be in use."—*The Practical Teacher.*

"There is in the book a maximum of knowledge in a minimum of space. No words are wasted, and there is no hint given which does not need to be emphasised."—*The Educational Times.*

---

Second Edition. Crown 8vo, cloth. Price 1s.

# French Words & Phrases

By J. G. ANDERSON and F. STORR

"A valuable aid to the study of French."—*The Bradford Observer.*

---

London: WILLIAM RICE, 3 Broadway,
Ludgate Hill, E.C.

then $S = Vt_1 + \frac{1}{2}ft_1^2$ . . . . . (2).

Similarly if $t_2$ denotes the time occupied in moving through the second interval, then as the spaces described are equal we obtain the relation

$$2S = V(t_1 + t_2) + \frac{1}{2}f(t_1 + t_2)^2 \quad . \quad . \quad . \quad . \quad (3).$$

Equations (2) and (3) containing the two unknowns V and $f$ will enable V to be eliminated and the value of $f$ to be determined.

As the equal intervals are each 80 feet, we obtain from (2)

$$80 = V \times 5 + \frac{1}{2}f \times 25,$$

$$\text{or} \quad 16 = V + \frac{5}{2}f \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

Similarly from (3) on substitution

$$160 = 9V + \frac{1}{2}f \times 81 \quad . \quad . \quad . \quad . \quad . \quad (5).$$

Multiply (4) by 9 and subtract from (5),

$\therefore 16 = 18f$, or $f = 8 \div 9$.

Ex. 7. Find the acceleration of the velocity of a body sliding down a rough inclined plane, and hence find the increase of the kinetic energy when a body has moved over a given length of the plane.

Let $m$ be the mass of the body, $\alpha$ the inclination of the plane, and $\mu$ the coefficient of friction.

Then from the relation $F = mf$ we find

$$f = (\sin\alpha - \mu\cos\alpha)g.$$

If V is the initial and $v$ the final velocity of a body, then $v^2 - V^2 = 2fs$; this gives the increase in the velocity in moving over a distance $s$,

$\therefore$ increase in kinetic energy may be found from

$$\frac{1}{2}m(v^2 - V^2).$$

Ex. 8. (i) Explain how engineers, in constructing a railway, enable a train to steam safely round a curve.

(ii) If the line be made so that a certain curve, radius 500 feet, is adapted to a speed of 30 miles an hour, find the side pressure on the rails when a 50 ton train travels round the curve at 15 miles an hour.

The outer rail (*i.e.* the rail farthest from the centre of the curve) is made higher than the inner rail, thus imaginary lines joining the two rails would form a plane at an inclination $\alpha$ to the horizon.

If W is the weight of the train, then the component of W down the plane or W sin $\alpha$ must be equal to the centrifugal force F where $F = \frac{Wv^2}{gr}$.

The inclination $\alpha$ may be found from the equation

$$W\sin\alpha = \frac{Wv^2}{gr}.$$

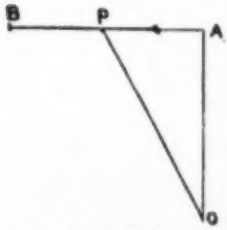
$$\text{Now 30 miles per hour} = \frac{30 \times 5280}{60 \times 60} = 44 \text{ feet per second},$$

$$\therefore \sin\alpha = \frac{44^2}{32{\cdot}2 \times 500} = 0{\cdot}1202.$$

15 miles per hour = 22 feet per second,

$$\therefore \text{side pressure on rails} = W\left(\cdot1202 - \frac{22^2}{32{\cdot}2 \times 500}\right)$$

$$= 50(\cdot1202 - \cdot03005) = 50 \times \cdot0901 = \underline{4{\cdot}5 \text{ tons}}.$$




Ex. 9. Define the angular velocity of a moving point with reference to a given fixed point.

Draw O A at right angles to a straight line A B; a point moves with uniform velocity V along A B; when it is at any point P, show that its angular velocity with respect to O equals V × O A ÷ O P².

Let P be the position of a moving point at a given instant moving with velocity V in the direction A B.

Resolve the velocity V into two components, V cos $\theta$ along P O, and V sin $\theta$ perpendicular to it.

($\theta$ denoting the angle O P A), the former produces no angular velocity about O, the latter gives an angular velocity V sin $\theta \div$ O P.

Draw O A perpendicular to A B, then sin $\theta$ = O A ÷ O P.

$\therefore$ Angular velocity about O = $\omega$ = V × O P ÷ O P².

Ex. 10. (*a*) Assuming the formula $t = \pi\sqrt{\frac{l}{g}}$, calculate the length of the simple pendulum that beats seconds at a place where $g = 32{\cdot}2$.

(*b*) If the length of a seconds pendulum is increased by the one-thousandth part, show that the clock will lose about 43 seconds a day.

(*a*) $t^2 = \frac{\pi^2 l}{g}$ or $l = \frac{gt^2}{\pi^2}$

$$\therefore l = \frac{32{\cdot}2 \times 1 \times 12}{\pi} = 39{\cdot}14 \text{ inches}.$$

(*b*) $39{\cdot}14 \div 1000 = \cdot039$ and $39{\cdot}14 + \cdot039 = 39{\cdot}179$

$$t = \pi\sqrt{\frac{39{\cdot}179}{32{\cdot}2 \times 12}}$$

one day = 60 × 60 × 24 = 86400 seconds.

$\therefore$ Time taken for 86400 vibrations = 86442 seconds × $t$ = 86442 seconds.

Hence loss = 86442 − 86400 = 42 seconds.

Ex. 11. Investigate the work required to compress air at pressure $p$ and volume $v$ to the volume V, the temperature remaining constant during the compression.

Show that about 188000 foot pounds of work are required to compress a cubic yard of atmospheric air to the volume of a cubic foot. N.B.—Pressure of atmosphere 14·7 lbs per square inch: $\log_e 3 = 1{\cdot}0986$.

$$\text{Work done} = pv\log_e\frac{V}{v}.$$

$p = 14{\cdot}7 \times 144$ lbs. per square foot.

$v = 27$ cubic feet.

Also $V \div v = 27$.

$\therefore$ Work done $= 14{\cdot}7 \times 144 \times 27 \times \log_e 3^3$.

$\log_e 3^3 = 3 \times 1{\cdot}0986 = 3{\cdot}2958$.

$\therefore$ Work done $= 14{\cdot}7 \times 144 \times 27 \times 3{\cdot}2958$ foot pounds

$= 188000$ foot pounds.

Ex. 12. Define the "modulus of elasticity" of a solid.

An iron rod 10 feet long, held by one end, is stretched a tenth of an inch when it carries a weight of 3000 lbs. If a quarter of the weight were taken off, by how much would it then be stretched? If the cross-section of the rod is 3/20ths of a square inch, what is the modulus of elasticity in pounds per square inch?

Let E denote the modulus of elasticity, then E = stress ÷ strain.

Where stress is load ÷ area of cross-section, and strain is alteration of length ÷ original length. Let A denote the area of cross-section.

$$\text{Strain} = \frac{\frac{1}{10}}{120} = \frac{1}{1200}$$

$$E = \frac{3000}{A} \div \frac{1}{1200} = \frac{3000 \times 1200}{A} \quad . \quad . \quad . \quad . \quad . \quad (1).$$

The load becomes 2250 when a quarter is removed.

Let $x$ = elongation produced.

$$\text{Then } E = \frac{2250}{A} \div \frac{x}{120} = \frac{2250 \times 120}{A\,x}$$

$$\text{Hence } \frac{3000 \times 1200}{A} = \frac{2250 \times 120}{A\,x}$$

$$\therefore x = \frac{2250 \times 120}{3000 \times 1200} = \frac{3}{40} \text{ inch}.$$

$$\text{From (1) } E = \frac{3000 \times 1200 \times 20}{3} = 24{,}000{,}000 \text{ or } 2{\cdot}4 \times 10^7.$$

Ex. 13. What is meant by the pressure at a point and the total pressure on a surface in a liquid?

A hollow cone filled with water is held with its vertex downwards and axis vertical; the length of the axis is 12 feet, and the radius of the base 5 feet; find the total pressure on its surface.

I.

"I joined another class some time ago, and have found it anything but satisfactory. The result is that now 'I'm in a hole.'" (Later.) "Your papers are far better than those I have been accustomed to receive."

III.

"I can safely assert, and without fear of contradiction, that the papers sent out by you are the best to be had—I have had ample opportunity of judging."

# MR. H. J. SMITH'S CLASSES

*(Conducted by Mr. H. J. Smith, B.Sc. Lond., St. Mark's 1884–92)*

## SCHOLARSHIP. CERTIFICATE. MATRIC. A.C.P.

**Grand Successes at recent Scholarship Examination.**

**SMALL CLASSES. INDIVIDUAL ATTENTION.**

Read Genuine Testimonials in New Prospectus.
Send for Specimen Papers. . . . . .

**Many Successes at January Matric, and A.C.P.**

**MONTHLY FEES. THE BEST NOTES. THE BEST TUTORS.**

**Address:**
**ROSEBERY HOUSE, BREAM'S BUILDINGS, E.C.**

**ORAL CLASSES**
*meet every Saturday at*
St. Martin's Schools,
Charing Cross,
London, W.C.

**TUITION BY POST**
*from*
Rosebery House,
Bream's Buildings,
Chancery Lane,
London, E.C.

II.

"Had I seen your specimen papers before, I would have joined your class ten weeks ago, instead of wasting my time with . . ."

IV.

"I have received lessons from two other Correspondence Classes, but I can honestly say that your notes are the best I have ever used."

# GIBSON'S PHONIC READERS.

THE System adopted in this series of Readers is the **PHONETIC.** The aim is to simplify the process, and to make the acquirement of Reading more attractive and progressive, by using only those words which admit of phonetic analysis, and by careful gradation of difficulties.

Exceptional words are introduced by degrees, and are taught by the "**Look and Say**" method.

To avoid unnecessary detail, which is confusing and irritating alike to pupil and teacher, one sound only of a letter or combination of letters is taught in the early stages.

As the chief difficulty of the system lies in the power of the vowel sound, the greater part of the first Reader is built on the short vowel, so that the child may become familiar with one series of words before proceeding to another.

Colour has been introduced to brighten otherwise dull lists of words, and as an aid in maintaining attention.

**Part I.—Paper, 2d.; Cloth, 3d.**
**II.—Paper, 4d.; Cloth, 5d.**
**III.—Cloth, 7d.**
**Phonic Word-building Practice Sheets, 7s. 6d. per Set.**

When pupils have thoroughly mastered the above Series, they are able to read at sight any book of average difficulty.

**ROBERT GIBSON & SONS (Glasgow), Ltd.,**
45 QUEEN STREET, GLASGOW.

# G. W. BACON & CO., Ltd.

*Are the Publishers of*

EXCELSIOR WALL MAPS (20 Full, 20 Test, at 15s. each.
" Reduced Maps (30 by 40), at 6s. each.
" Bold Feature Maps (30 by 40), at 6s. each.
" Special Maps and Diagrams at 6s. each.

EXCELSIOR WALL ATLASES, each containing four to eight Maps, 30 by 40, Political and Bold Feature; Fourteen Parts Ready. Atlases made up specially to suit any Scheme of Geography at 3s. 6d. per Sheet.

NATURAL HISTORY, Popular Pictures, Familiar Folk, and Blackboard Charts for Object Teaching in great variety.

DRAWING CHARTS, Cards, and Books, for all kinds of Drawing, whether in Infants', Elementary, Secondary, or Art Schools.

Their BRUSH WORK and NATURE COURSES are complete and exhaustive, and increase in popularity every day. Send for Special Drawing Catalogue post free.

All Infant and Girls' Mistresses commencing Drawing should see the PRIMARY DRAWING COPY-BOOKS just issued.

Artistic Drawing, Natural Colouring, the Best of Printing, and Excellent Materials are among the distinguishing features of Bacon's publications. Catalogues and Specimens Free.

**G. W. BACON & CO., Limited**
127 STRAND, LONDON

The pressure at a point denotes the pressure on a small area at or near the point.

The total pressure is the sum of the pressures on all the elements of the surface and is equal to the product of the area of the surface, the depth of the centre of area (or centre of gravity), and the weight of unit volume.

$\therefore$ P = $w$AZ, where P denotes the pressure on an area A and Z the depth of the centre of area.

Let $r$ and $h$ denote the radius of the base and length of axis respectively.

Area of curved surface = $\pi r\sqrt{x^2 + h^2} = 5\pi\sqrt{25 \times 144} = 65\pi$.

Taking the weight of a cubic foot of water to be 62·3 lbs.

$$\therefore \text{Total pressure} = \frac{65\pi \times 62{\cdot}3 \times 12}{3} = 50900 \text{ lbs.}$$

**Ex. 14.** Determine the tension of a thin flexible cylinder under internal fluid pressure.

If the internal pressure be 100 lbs. per square inch, and the radius of the cylinder 2 inches, what is the tension that resists rupture along a line running longitudinally?

Let $r$ denote the radius of the cylinder and $l$ its length.

If $p$ is the internal pressure, then (neglecting external pressure) the magnitude of the resultant pressure on one side of any diametral plane is $2rlp$. This force is, balanced by the parallel forces furnished by the edges of the rectangle. If T denotes the thickness of the cylinder, S the tenacity or tensile strength of the material of which the cylinder is made, then the greatest tension which can be furnished by the edges of the rectangle is 2TS$l$. Hence equating we obtain

$$p \times 2rl = 2TSl \text{ or } p = \frac{TS}{r}.$$

When the thickness is very small, the tension $t$ per unit length replaces TS.

$$\therefore t = pr.$$

Substituting the given values

$$t = 100 \times 2 = 200 \text{ lbs.}$$

Two tubes of the same material and of equal lengths have to sustain fluid pressures of equal intensity; show that they are equally safe, if (the material being thin) their weights are proportional to the squares of their diameters.

# MATHEMATICS.

## (STAGE 2.)

BY FRANK CASTLE, M.I.M.E.

**Ex. 1.** (*a*) Reduce the fraction $\frac{2\sqrt{5} - 1}{3 - \sqrt{5}}$ to an equivalent fraction with a rational denominator; and having done so, find its value as a decimal, having given $\sqrt{5} = 2{\cdot}236$.

(*b*) Given $\sqrt{2} = 1{\cdot}41421$ and $\sqrt{3} = 1{\cdot}73205$, show that

$$\sqrt{\left(\frac{(\sqrt{3} - \sqrt{2})}{\sqrt{3} + \sqrt{2}}\right)} < \frac{8}{25}.$$

(*a*) $$\frac{(2\sqrt{5} - 1)(3 + \sqrt{5})}{(3 - \sqrt{5})(3 + \sqrt{5})} = \frac{5\sqrt{5} + 7}{4}.$$

Substituting the given value, this becomes

$$\frac{18{\cdot}18}{4} = 4{\cdot}545.$$

(*b*) $$\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}} = \frac{(\sqrt{3} - \sqrt{2})^2}{(\sqrt{3} + \sqrt{2})(\sqrt{3} - \sqrt{2})} = \frac{5 - 2\sqrt{6}}{1}.$$

Let $\sqrt{\left(\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}}\right)}$ or $\sqrt{5 - 2\sqrt{6}} = \sqrt{x} - \sqrt{y}$.

Squaring, we obtain $5 - 2\sqrt{6} = x + y - 2\sqrt{xy}$,

$$\therefore x + y = 5, \text{ and } 2\sqrt{xy} = 2\sqrt{6},$$
$$(x+y)^2 = 25 \text{ (1), and } 4xy = 24 \text{ (2).}$$

Subtract (2) from (1),

$$\therefore (x - y)^2 = 1.$$

Hence $x + y = 5$, $x - y = 1$.

$$\therefore x = 3, y = 2.$$

Thus $$\sqrt{\left(\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}}\right)} = \sqrt{3} - \sqrt{2}$$
$$= 1{\cdot}73205 - 1{\cdot}41421 = {\cdot}31784.$$

Now $\frac{8}{25} = {\cdot}32$.

Hence $$\sqrt{\left(\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}}\right)} < \frac{8}{25}.$$

**Ex. 2.** (*a*) Explain how to solve the equation $ax^2 + bx + c = 0$, and find the condition that the roots be real and unequal.

(*b*) Find whether the equation $101x^2 - 143x + 51 = 0$ has real roots.

(*a*) $$ax^2 + bx + c = 0,$$

or $$x^2 - \frac{b}{a}x = -\frac{c}{a} \text{ completing the square,}$$

$$\therefore x^2 - \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \frac{b^2}{4a^2} = \frac{b^2 - 4ac}{4a^2},$$

$$\therefore x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a} \quad \ldots \quad (1)$$

The following important cases occur:—

(i.) The roots given by (1) are real and unequal when $b^2$ is greater than $4ac$.

(ii.) The roots are equal when $b^2 = 4ac$, and

(iii.) No real roots when $b^2$ is less than $4ac$.

(*b*) Here $a = 101$, $b = 143$, and $c = 51$. Substituting these values we obtain

$$x = \frac{143 \pm \sqrt{143^2 - 4 \times 101 \times 51}}{202}$$
$$= \frac{143 \pm \sqrt{20449 - 20604}}{202}.$$

Hence there are no real roots.

**Ex. 3.** Solve the equations:—

(*a*) $$x^2 - x\sqrt{5} + 1 = 0.$$

(*b*) $$x^2 - 3 + \frac{1}{x^2} = 0.$$

(*c*) $$(5x + 1)(4y - 1) = 36, \; 4xy = 7.$$

Write down $x^2 - x\sqrt{5} + 1$ in factors.

(*a*) This may written in the form

$$x^2 - \sqrt{5}x = -1.$$

Add to each side of the equation the square of one-half the coefficient of $x$.

$$\therefore x^2 - \sqrt{5}x + \left(\frac{\sqrt{5}}{2}\right)^2 = -1 + \frac{5}{4} = \frac{1}{4}.$$

$$\therefore x = \frac{\sqrt{5}}{2} \pm \frac{1}{2} = \frac{\sqrt{5} \pm 1}{2}.$$

(*b*) $$x^2 - 3 + \frac{1}{x^2} = 0,$$

or $$x^4 - 3x^2 = -1,$$

$$x^4 - 3x^2 + \left(\frac{3}{2}\right)^2 = \frac{9}{4} - 1 = \frac{5}{4},$$

$$\therefore x^2 = \frac{3}{2} \pm \frac{\sqrt{5}}{2} = \frac{3 \pm \sqrt{5}}{2},$$

$$\text{hence } x = \sqrt{\frac{3 \pm \sqrt{5}}{2}}$$

(*c*) $$(5x + 1)(4y - 1) = 36 \text{ (1)}; \; 4xy = 7 \text{ (2)},$$

or $$20xy + 4y - 5x = 37.$$

Multiply (2) by 5 and subtract

$$\therefore \frac{20xy}{4y - 5x} = \frac{35}{2} \text{ (3).}$$

From (2) $x = \frac{7}{4y}$ substitute this value for $x$,

$$\therefore 4y - \frac{35}{4y} = 2,$$

or $$16y^2 - 8y = 35,$$

$$\therefore y^2 - \frac{1}{2}y + \left(\frac{1}{4}\right)^2 = \frac{35}{16} + \frac{1}{16} = \frac{36}{16},$$

$$\therefore y = \frac{1}{4} \pm \frac{6}{4} = \frac{7}{4} \text{ or } -\frac{5}{4},$$

and from (3) by substitution $x = 1$, or $-\frac{22}{5}$.

$$x^2 - x\sqrt{5} + 1 = \left(x - \frac{\sqrt{5} + 1}{2}\right)\left(x - \frac{\sqrt{5} - 1}{2}\right).$$

# AYRES' CLASSES

## CORRESPONDENCE CLASSES
FOR
## Pupil Teachers
AND
## Scholarship
**1906**

*BEGIN MARCH 28.*

## CLASSES
FOR
## Scholarship
**1905 and 1907**
## Certificate
**1906**

*BEGIN A NEW QUARTER MARCH 30.*

***Syllabus, Book List, &c., on Application***

The above Classes have been officially chosen by the Education Committee of one of the largest counties for all their teachers to join.

**BEST PREPARATION OBTAINABLE**

***Intending Students should join at once.***

## ORAL CLASSES
MEET AT
**181 ALDERSGATE STREET, E.C.**

**For Prospectus, Testimonials, &c., apply to—**

## Mr. H. B. AYRES
**4 ARUNDEL SQUARE, BARNSBURY, LONDON, N.**

# My Need!

A thoroughly Well-Qualified, Up-to-Date, Reliable Assistant—crammed with the products of experience—overflowing with hints and suggestions of the most useful kind.

**HOW TO SATISFY IT:**
BY TAKING
## The Teachers' Aid

An immensely Practical Weekly Journal, indispensable to all Classes of Teachers—Heads, Assistants, Pupil Teachers.

**Every conceivable phase of School Subjects dealt with in able and original manner.**

**Full of latest information—in fact, right abreast of the tape.**

**Full of surprising suggestions.**

**Unique devices devised, described, and explained.**

**A Real Aid to the - - Wide-awake Teacher**

**TERMS OF SUBSCRIPTION.**

**Post free—Twelve Months, 6s.;**
**Six Months, 3s. 3d.;**
**Three Months, 1s. 8d.;**
**or in Monthly Parts, 7d.**

**Address:**
**MANAGER, 3 Racquet Court, Fleet Street, London, E.C.**

**Ex. 4.** The areas of a square and a rectangle are equal, and the perimeter of the rectangle is $n$ times that of the square; find the sides of the rectangle in terms of a side of the square.

Verify your result in the case in which $4n = 5$.

Let $x$ and $y$ denote the sides of the rectangle, and let $a$ denote the side of the square; perimeter of rectangle $= 2(x + y)$, of square $= 4a$.

$$\therefore xy = a^2 \quad \ldots (1),$$

$$\text{and} \quad 2(x + y) = 4na;$$

$$\text{or} \quad x + y = 2na \quad \ldots (2).$$

$$\text{Squaring} \quad (x + y)^2 = 4n^2a^2 \quad \ldots (3).$$

Multiply (1) by 4, and subtract from (3).

$$\therefore (x - y)^2 = 4n^2a^2 - 4a^2 = 4a^2(n^2 - 1);$$

$$\text{or} \quad x - y = 2a\sqrt{(n^2 - 1)}.$$

From (2) $\quad x + y = 2na.$

By addition $2x = 2na + 2a\sqrt{(n^2 - 1)}$;

or $x = a(n + \sqrt{n^2 - 1})$;

Also by subtraction $y = a(n - \sqrt{n^2 - 1})$;

if $4n = 5$, then $n = \frac{5}{4}$; substitute this value

$$\therefore x = a\left[\frac{5}{4} + \sqrt{\left(\frac{25}{16} - 1\right)}\right] = 2a,$$

$$y = a\left[\frac{5}{4} - \frac{3}{4}\right] = \frac{a}{2}.$$

Hence, when $n = \frac{5}{4}$, the sides of the rectangle are $2a$ and $\frac{a}{2}$.

**Ex. 5.** Define a logarithm. Illustrate the rule that $\log \frac{b}{a} = \log b - \log a$ by taking common logarithms and letting $b = 1000$, $a = 10$, and proving that the rule is true in this case.

Find by logarithms the numerical values of (*a*) $(2{\cdot}45)^{10}$; (*b*) $\left(\frac{2}{7}\right)^{\frac{3}{5}}$; (*c*) $(\tan 29° 45')^3$. How is it known before the last calculation is made that the result (*c*) should come out a little less than $\frac{1}{3}$?

As $1000 = 10^3$ $\therefore \log \left(\frac{10^3}{10}\right) = \log (10^2)$, or $2 \log 10$.

Also $\log 10^3 - \log 10 = 3 \log 10 - \log 10 = 2 \log 10$.

(*a*) On referring to the table of logarithms supplied, we find that $\log 2{\cdot}45$ is not given, but as $\log 2$ and $\log 7$ are given, we may write the expression in the form $2{\cdot}45 = \frac{10}{2} \times {\cdot}7^2$.

Let $x = (2{\cdot}45)^{10}$

$\log x = 10(2 \log {\cdot}7 + \log 10 - \log 2)$

$= 10(\bar{1}{\cdot}8450980 \times 2 + 1 - {\cdot}3010300) = 3{\cdot}891660.$

$\therefore x = 7792{\cdot}2.$

(*b*) Let $y = \left(\frac{2}{7}\right)^{\frac{3}{5}}$. $\therefore \log y = \frac{3}{5}(\log 2 - \log 7)$

$= \frac{3}{5}({\cdot}3010300 - {\cdot}8450980) = \frac{3}{5}(\bar{1}{\cdot}4559320),$

or $\frac{3}{5}(-{\cdot}5440680) = \bar{1}{\cdot}6735592.$

From tables, $\log 47159 = {\cdot}6735646.$

$\log 47158 = {\cdot}6735554$

$\qquad\qquad {\cdot}0000092$

Also ${\cdot}6735592 - {\cdot}6735554 = {\cdot}0000038.$

and $\frac{3800}{92} = 41.$ $\therefore \bar{1}{\cdot}6735592 = {\cdot}4715841.$

(*c*) The value of $\tan 29° 45'$ is less than $\tan 30°$, but $\tan 30° = \frac{1}{\sqrt{3}}$. $\therefore \tan^2 30° = \frac{1}{3}$.

Hence $(\tan^2 29° 45')^3$ is less than $\frac{1}{3}$.

To find its numerical value—

$\log (\tan 29° 45')^3 = 9{\cdot}7590520 \times 2 = 19{\cdot}5141040 - 20$

$= \bar{1}{\cdot}5141040.$

From tables, $\log 32667 = 4{\cdot}5141093$

$\log 32666 = 4{\cdot}5140960$

$\qquad\qquad {\cdot}0000133.$

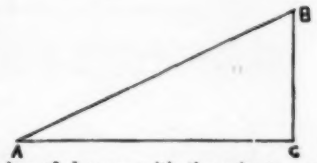
Also ${\cdot}5141040 - {\cdot}5140960 = {\cdot}0000080.$

$\therefore 800 \div 133 = 6.$

$\therefore (\tan 29° 45')^3 = {\cdot}3266660.$

**Ex. 6.** (*a*) Define the sine, cosine, and tangent of an angle less than a right angle.

(*b*) If ABC is a triangle having a right angle at C, and such that $a = 3$ and $c = 7$ units. Write down the numerical value of the sine of A, find the true logarithm of sin A; the tabular logarithm, and the number of degrees with the minutes and seconds in the angle A.




(*c*) Draw the triangle to scale, and verify your calculation by measuring the angle with a protractor.

(*a*) $\sin A = \frac{BC}{AB}$, $\cos A = \frac{AC}{AB}$, $\tan A = \frac{BC}{AC}$;

(*b*) $\sin A = \frac{3}{7}$,

$\log \sin A = \log 3 - \log 7$

$= {\cdot}4771213 - {\cdot}8450980 = \bar{1}{\cdot}6320233.$

$\text{L} \sin A = 9{\cdot}6320233.$

$\text{L} \sin 25° 23' = 9{\cdot}6321255 \qquad 9{\cdot}6320233 - 9{\cdot}6318591.$

$\text{L} \sin 25° 22' = 9{\cdot}6318591 \qquad = {\cdot}0001642.$

$\qquad\qquad {\cdot}0002664$

$\therefore 1642 \times 60 \div 2664 = 37.$

Hence $A = 25° 22' 37''$.

**Ex. 7.** (*a*) In the equation $\cos^2\theta - \sin^2\theta = 2 - 5\cos\theta$, find $\cos\theta$, and explain why one of the values of $\cos\theta$ given by the equation is impossible. Write down two values of $\theta$ that satisfy the equation.

(*b*) Reduce to its simplest form

$$\frac{\cos(180° - A)\sin(360° - A)\cot(90° + A)}{\tan(180° + A)\cos(-A)\tan(90° - A)}.$$

(*a*) $\quad \cos^2\theta - (1 - \cos^2\theta) = 2 - 5\cos\theta.$

$\therefore 2\cos^2\theta + 5\cos\theta = 3,$

or $\quad \cos^2\theta + \frac{5}{2}\cos\theta + \left(\frac{5}{4}\right)^2 = \frac{3}{2} + \frac{25}{16} = \frac{49}{16}.$

$$\therefore \cos\theta = \frac{5}{4} \pm \frac{7}{4} = \frac{1}{2} \text{ or } -3.$$

As the value of $\cos\theta$ cannot exceed unity, the second value is impossible.

Taking the former value $\theta = 60°$ or $300°$.

(*b*) The given terms are equivalent to

$$\frac{(-\cos A)(-\sin A)\tan A}{\tan A \cdot \cos A \cot A} = \frac{\sin^2 A}{\cos A}.$$

(*To be continued next month.*)


## THE HARMSWORTH ENCYCLOPÆDIA.

Hundreds of Specialists have been engaged in the preparation of the HARMSWORTH ENCYCLOPÆDIA. From cover to cover it is an entirely new work. Brimful of original illustrations, and beautifully printed, it gives the pith and essence of the world's accumulated knowledge. For exactly one ½d. per day our readers can have in the home or office the most up-to-date book in the world. Practical everyday questions are dealt with, and with such an indispensable work at hand one need never be at a loss for facts, dates, or statistics. The first of the Sevenpenny fortnightly parts is now on sale at all Newsagents.

# 1905. MACMILLAN'S CONFERENCE EXHIBIT. 1905.

## NEW PUBLICATIONS TO BE SEEN AT MACMILLAN'S STALL, No. 38.

**READERS.**

**MACMILLAN'S "NEW GLOBE" READERS.** An entirely New Set of Literary Readers. The Infant Series (4 books) beautifully Illustrated in Colours, Books I. and II. ready.

**Macmillan's Story Readers.** Introductory, Books I. and II. Illustrated by Actual Photographs of Children.

**Junior Country Readers.** I., II., III.

**Senior Country Readers.** I., II., III.
*Every Teacher in Town and Country should see this Series of Readers.*

**The "Globe" Geography Readers.** By V. T. MURCHÉ, F.R.G.S.

**New History Readers,** on Concentric Plan and correlated with Geography. Primary, Junior, Intermediate, and Senior.

**Nature Knowledge Readers.** By V. T. MURCHÉ, F.R.G.S.

**DRAWING.**

**Nature Study Drawing Cards.** The only series giving the *Actual Leaf*, and showing its application to Design in Firm and flexible Point Drawing.

**ARITHMETIC.**

**Macmillan's PICTURE ARITHMETIC.** I., II., III. A Novel Supplementary Series for Young Children.

**Scheme B.** Arithmetic for Promotion. I. to VII.

**Scheme B. Monthly Test Books.** I. to VII. The most systematic course entirely in the concrete yet published.

**HYGIENE, &c.**

**Primer of Hygiene.** By Professor REYNOLDS. 1s.

**Murché's Domestic Science Readers.** I. to VII. Covering a full course of Lessons on Food, Clothing, Washing, Laws of Health, Temperance, Infant Management, Common Accidents, and the Management of the Sickroom, &c.

**SINGING.**

**British Songs for British Boys.** Editions A, B, and C.

**SECONDARY and HIGHER BOOKS.**

A large selection of New Books on the New Geometry and other subjects will be exhibited.

*See full Catalogue Free on Application.*

Representatives Present—
Messrs. A. E. PITT, E. W. WESTMACOTT, and H. C. CASTLE.

**MACMILLAN & CO., Ltd., ST. MARTIN'S STREET, LONDON, W.C.**

# Nelson's Sixpenny Classics

**CLOTH 6d. NET**

An **entirely New Series** of the most popular reprints. Each volume will contain nearly **600** pages in **Large Type,** with specially produced Frontispiece, and will be **tastefully** bound in **Cloth.** All the volumes will be unabridged.

**CLOTH 6d. NET**

*List of First Six Volumes in Active Preparation*

READY IN APRIL

**A TALE OF TWO CITIES.** DICKENS.

**TOM BROWN'S SCHOOLDAYS.** HUGHES.

**THE DEERSLAYER.** FENIMORE COOPER.

READY IN MAY

**HENRY ESMOND.** THACKERAY.

**HYPATIA.** KINGSLEY.

READY IN JUNE

**THE MILL ON THE FLOSS.** GEORGE ELIOT.

*** ***Other Volumes will appear at regular intervals.***

"Nothing like it has been attempted in the world before. . . . Such books . . . will be considerably read, and the reading of them must raise the standard, and help to form the reading habit."—*British Weekly.*

THOMAS NELSON & SONS, 35 & 36 PATERNOSTER ROW, LONDON
EDINBURGH, DUBLIN, and NEW YORK

# OUR QUERY COLUMN

**RULES.**

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

*X.Y.Z.*—A sash-window of height $h$ is counterbalanced by weights; show that it can be raised by a vertical force if its point of application is not further than $\frac{1}{2}h$ cot $\alpha$ from the centre, where $\alpha$ is angle of friction.

(Second Stage Mechanics, 1903.)

Suppose a vertical force F applied at a point distant $x$ from the vertical through the centre of the sash. At the centre of the sash suppose two opposite forces to be placed, each equal and parallel to F. We have then, instead of the original force F, an equal force F acting vertically at the centre of the sash and the couple F$x$. Now this couple is balanced by the reaction of the frame at top and bottom on opposite sides of the sash. Hence if R be the reaction on either side we have

$$Rh = Fx. \quad . \quad . \quad . \quad . \quad (1).$$

When the sash is just moving, the frictional resistance is $2\mu R$, where $\mu = \tan\phi$.

It follows therefore that the sash will move if

$2\mu R$ is not greater than F.

But from (1) we see that $F = \frac{Rh}{x}$

Therefore the sash will move if

$2\mu R$ is not greater than $\frac{Rh}{x}$,

that is if $2\mu$ is not greater than $\frac{h}{x}$,

that is if $x$ is not greater than $\frac{h}{2\mu}$

Hence the sash can be raised by a vertical force if its point of application is not further than $\frac{1}{2}h$ cotan $\phi$ from the centre, where $\phi$ is the angle of friction.

*S.H.W.*—One end of a uniform rod is attached to a hinge and the other end is supported by a string attached to the extremity of the rod and inclined to the horizontal at the same angle $\theta$ as the rod. If W is the weight of the rod, prove that the stress on the hinge is

$$\tfrac{1}{2}W\sqrt{8 + \operatorname{cosec}^2\theta}.$$

(Tutorial Statics.)

(*Note.*—A solution which does not involve the notion of *moments* is asked for.)

Let AB be the rod hinged at A, and BC the direction of the string. Take E, the middle point of AB, and through E draw the vertical ED cutting BC in D. Then, since AB is in equilibrium under the action of two forces in the directions DE, BC, and a third force due to the reaction of the hinge, the direction of the last must pass through D, the intersection of the former two. Through A draw the vertical AC, meeting BC, the direction of the string, in the point C. Then by the triangle of forces, the weight of the rod, the reaction of the hinge, and the

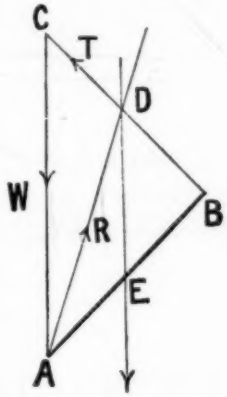



FIG. 1.

tension in the string must be proportional to the three sides of the triangle CAD.

Since BC is inclined to the horizontal at the angle $\theta$, the angle ACD is equal to $90° - \theta$. Denote the angle DAC by $\phi$. Then the angle ADC is equal to $\theta + 90° - \phi = 90° - (\phi - \theta)$.

Now from the triangle CAD we have

$$\frac{AD}{CA} = \frac{\sin ACD}{\sin ADC}. \qquad \therefore \frac{R}{W} = \frac{\cos\theta}{\cos(\phi - \theta)}. \quad . \quad . \quad . \quad . \quad (1).$$

Again from the triangle ABD we have

$$\frac{AB}{BD} = \frac{\sin ADB}{\sin DAB}.$$

Now $ADB = 90° - \theta + \phi = 90° - (\theta - \phi)$. And $DAB = 90° - (\theta + \phi)$. Also $DB = BE = EA$.

$$\therefore AB = 2\,BD.$$

$$\text{Hence } \frac{\cos(\theta - \phi)}{\cos(\theta - \phi)} = 2.$$

$$\therefore \cos(\theta - \phi) = 2\cos(\theta + \phi). \quad . \quad . \quad . \quad . \quad . \quad . \quad (2).$$

$$\text{But } \cos(\theta - \phi) = \cos(\phi - \theta).$$

Hence (1) may be written

$$\frac{R}{W} = \frac{\cos\theta}{2\cos(\theta + \phi)}$$

$$\therefore R = \frac{W}{2} \cdot \frac{1}{\cos\phi - \sin\phi\tan\theta}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (3).$$

THE
**EDUCATIONAL MUSICAL INSTRUMENT CO.**
(ESTABLISHED 1881)

Is now supplying a
***Second Generation***
WITH
**PIANOS, AMERICAN ORGANS, HARMONIUMS, ETC.**

For LISTS AND DESIGNS apply to the
MANAGER,
43, Estate Buildings, Huddersfield;
21, Argyle Crescent, Portobello, Edinburgh;
3, Unity Street, Bristol;
or, 19, Highbury Place, London, N.

**MANY THOUSANDS** of Teachers, School Managers, etc., including **Twenty-five of H.M. Inspectors of Schools,** are using and recommending our Instruments, of which we have specimens **in every County of the British Isles.**

***SCHOOL PIANOS, Etc., A SPECIALITY.***

We have over 1,800 in use, our large trade enabling us to offer unapproached bargains. You would also find our Violin Outfits for Orchestral Classes unequalled in quality and price.

**Send for Designs of PIANO PLAYER and PHONOGRAPHS.**
Far superior to any offered at the same figure.

See our 45 Guinea Prize Medal Upright Iron Grand Piano for £21 cash, or 36 payments of 14s. 2d. per month. Quite new, rich full tone, and thoroughly durable.

We pay carriage, give a month's free trial, a ten years' warranty, and **exchange free of cost** if the instrument sent is not all that is desired.

DR. MACNAMARA, M.P., Editor of *The Schoolmaster*, writes under date August 30, 1904:—"We are more than delighted with the Piano which you recently selected for and supplied to us. Any of my friends who need an instrument cannot possibly do better than place themselves entirely in your hands."

Mr. J. H. YOXALL, M.A., M.P., Gen. Sec. N.U.T., writes:—"For the fourth time I have experienced, for myself or for relatives, the special value, wide selection, and expert advice which your clients gain. Each of the four Pianos has given perfect satisfaction."

Show-rooms open Daily. Call and see our Stock, or write for our List of Instruments for Home or School Use, specifying the class preferred, and you will find

**WE CAN SAVE YOU MANY POUNDS.**
***(Please mention this Paper.)***

**Keith Prowse & Co**
ESTABLISHED 100 YEARS.
NEW CENTURY
NEW MODEL
CASH £26
FREE DELIVERY

OR 30 MONTHLY INSTALMENTS OF 21/-
Come & See It
OR
WRITE FOR CATALOGUE
MENTIONING THIS PAPER
48 CHEAPSIDE LONDON E.C.

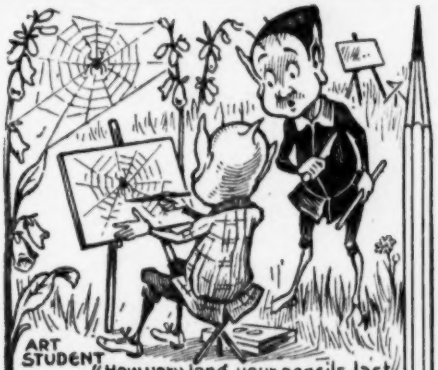
**TEACHERS**
will find in a
**"Swan"**
**Fountain Pen**
A Practical and ever Ready Helper.

**Of Invaluable Service**
For Reports, Corrections, Exercises, Shorthand, and Correspondence.
***Equally successful with coloured inks***
**10/6, 16/6, 25/- to £20**
post free
Of all Stationers and Jewellers
*Write for Catalogue*

**Mabie, Todd & Bard**
79 & 80 High Holborn
LONDON, W.C.
*BRANCHES:*—93 Cheapside, E.C.; 95a Regent Street, W.; 3 Exchange Street, MANCHESTER; and at NEW YORK and PARIS.

116 21/- 15/- 45/-

**For School Work the Best Pencil Made.**



ART STUDENT "How very long your pencils last. You use the same one all the time. All mine wear out and break so fast- A dozen to your one, yet I'm Particularly careful to Both use and sharpen them like you."
PROFESSOR: Oh no amount of care my lad Preserves an ill-made pencil long. For when the lead is coarse and bad You can't expect it to be strong. Don't waste your money any more, Buy only HARDTMUTH'S
**KOH-I-NOOR**
THE PENCIL WITH THE LASTING POINT.
'Twas never known to disappoint.
OF STATIONERS, ARTISTS' COLOURMEN, AND PHOTOGRAPHIC DEALERS.

From (2) we have

$$3 \sin\theta \sin\phi = \cos\theta \cos\phi.$$

$$\therefore \tan\theta = \frac{\cot\phi}{3} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

Hence (3) may be written

$$R = \frac{W}{2} \cdot \frac{1}{\cos\phi - \frac{\cos\phi}{3}} = \frac{W}{4} \cdot \frac{3}{\cos\phi} \quad . \quad . \quad . \quad . \quad (5)$$

Again from (4) we have

$$\tan\phi = \frac{\cot\theta}{3}$$

$$\therefore 1 + \tan^2\phi = \frac{9 + \cot^2\theta}{9} = \frac{8 + 1 + \cot^2\theta}{9} = \frac{8 + \operatorname{cosec}^2\theta}{9}.$$

$$\therefore \frac{1}{\cos\phi} = \frac{\sqrt{8 + \operatorname{cosec}^2\theta}}{3}.$$

Hence (5) may be written

$$R = \frac{W}{4} \sqrt{8 + \operatorname{cosec}^2\theta}.$$

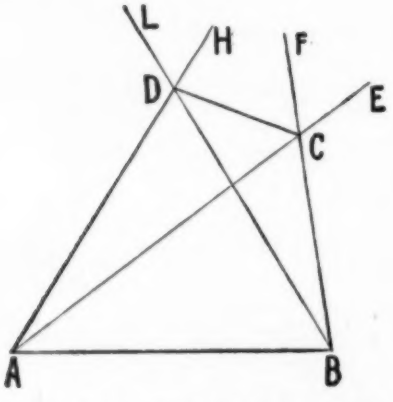
*Xuxis.*—There is a plane quadrilateral ABCD, in which AB = 193 feet, ∠ BAC = 37°, ∠ CAD = 21°, ∠ ABD = 59°, ∠ CBD = 23°; find the length of CD having given:—

| | | | |
|---|---|---|---|
| log 193 | = 2·2855573 | ∠ sin 82° | = 9·9957528 |
| log 218·52 | = 2·3394908 | ∠ sin 61° | = 9·9418193 |
| log 185·67 | = 2.2687420 | ∠ sin 59° | = 9·9330656 |
| log 32·85 | = 1·5165354 | ∠ sin 63° | = 9·9498809 |
| log 404·19 | = 2·6065856 | ∠ cot 10° 30′ | = 10·7320331 |
| log 80·4286 = 1·9054104 | | ∠ tan 23° 40′ 41″ | = 9·6419829 |
| | | ∠ sin 21° | = 9·5543292 |
| | | ∠ sin 55° 49′ 16″ | = 9·9176608 |

(Second Stage Mathematics.)

Show how to construct the figure.

On any convenient scale (say a scale on which one inch represents 50 feet) take AB to represent 193 feet. With a protractor set off ∠ BAE = 37°, ∠ EAH = 21°, ∠ ABL = 59° and ∠ LBF = 23°. Let C be the point of intersection of AE and BF, and D the intersection of AH and BL. Join BC, CD, DA. Then ABCD is the required figure.




In the triangle ABE we are given AB = 193 feet, ∠ ABC = 82°, ∠ BAC = 37°. Therefore ∠ ACB = 61°. Then from the formula

$$AC = \frac{\sin ABC}{\sin ACB} \cdot AB$$

$$\text{we have } AC = \frac{\sin 82^\circ}{\sin 61^\circ} \cdot 193.$$

Hence log AC = ∠ sin 82° + log 193 − ∠ sin 61° = 9·9957528 + 2·2855573 − 9·9418193.

$$\therefore \log AC = 2{\cdot}3394908.$$

Hence we have AC = 218·52 feet.

Again, in the triangle ABD we are given AB = 193 feet, ∠ ABD = 59°, ∠ DAB = 58°. Therefore ∠ ADB = 63°. Then from the formula

$$AD = \frac{\sin ABD}{\sin ADB} \cdot AB$$

$$\text{we have } AD = \frac{\sin 59^\circ}{\sin 63^\circ} \cdot 193.$$

Hence log AD = ∠ sin 59° + log 193 − ∠ sin 63° = 9·9330656 + 2·2855573 − 9·9498809.

$$\therefore \log AD = 2{\cdot}2687420.$$

Hence we have AD = 185·67 feet.

Then in the triangle DAC we have DA = 185·67 feet, AC = 218·52 feet, and the included angle DAC = 21°.

Denote the angle ADC by D, the angle ACD by C, and the angle DAC by A.

From the formula

$$\tan\tfrac{1}{2}(D - C) = \frac{AC - AD}{AC + AD} \cot\frac{A}{2}$$

$$\text{we have } \tan\tfrac{1}{2}(D - C) = \frac{32{\cdot}85}{404{\cdot}19} \cot 10^\circ\ 30'$$

Hence ∠ tan ½(D − C) = log 32·85 + ∠ cot 10° 30′ − log 404·19 = 1·5165354 + 10·7320331 − 2·6065856.

$$\therefore \angle \tan\tfrac{1}{2}(D - C) = 9{\cdot}6419829.$$

Referring to the given table, we see that ½(D − C) = 23° 40′ 41″, and ½(D + C) = ½(180° − A) = 90° − 10° 30′.

$$\therefore \tfrac{1}{2}(D + C) = 79^\circ\ 30'\ 0''.$$

$$\text{Hence } C = 55^\circ\ 49'\ 19''.$$

Finally, from the triangle ADC we have

$$\text{Hence we have} \qquad DC = \frac{\sin A}{\sin C} \cdot AD.$$

$$DC = \frac{\sin 21^\circ}{\sin 55^\circ\ 49'\ 19''} \cdot 185{\cdot}67.$$

$$\therefore \log DC = \angle \sin 21^\circ + \log 185{\cdot}67 - \angle \sin 55^\circ\ 49'\ 19''$$
$$= 9{\cdot}5543292 + 2{\cdot}2687420 - 9{\cdot}9176608.$$

$$\therefore \log DC = 1{\cdot}9054104.$$

Then from the given table we have CD = 80·4256.

*H.H.*—Supposing that one in $m$ is the steepest incline a train can crawl up with uniform velocity, and one in $n$ the steepest incline on which the brakes can hold the train, prove that the quickest run up an incline of one in $p$ from one station to stop at the next, a distance of $a$ feet, can be made in

$$\sqrt{\left\{\frac{\left(\frac{1}{n} + \frac{1}{m}\right) \cdot 2a}{\left(\frac{1}{m} - \frac{1}{p}\right)\left(\frac{1}{n} + \frac{1}{p}\right)g}\right\}} \text{ seconds.}$$

(B.Sc., London, 1903.)

From the first statement it is obvious that the greatest acceleration on the level is $\frac{1}{m} \cdot g$. Hence the greatest acceleration up a slope of one in $p$ is $\left(\frac{1}{m} - \frac{1}{p}\right)g$. Again, from the second statement the retardation on the level, when the brakes are on, is $\frac{1}{n} \cdot g$. Hence the retardation up a slope of one in $p$, when the brakes are on, is approximately $\left(\frac{1}{n} + \frac{1}{p}\right)g$.

Now, suppose the train to move up the given slope under the greatest possible acceleration for a distance $s$ in the time $t$, and then, the steam being shut off and the brakes applied, to move through $s$, the remaining portion of the space $a$, in the time $t$, and to come to rest at the end of this time. Then, if $f$ denote the greatest possible acceleration up the slope, we have

$$2s = ft^2.$$

Again, if $f$ denotes the retardation when the steam is shut off and the brakes applied, we have,

$$2s_1 = f_1 t_1^2.$$

Hence $2(s + s_1) = 2a = ft^2 + f_1 t_1^2$.

# RYDE'S CLASSES

**CORRESPONDENCE** { **SCHOLARSHIP 1905.** **CERTIFICATE 1906.** **A. C. P.** Final Section for the Autumn Examination. } **NEW SECTIONS** COMMENCE ON **Wednesday, March 29.**

*For Prospectus, Entry Form, Testimonials, Fees, &c., please apply to*

**Mr. PERCY W. RYDE, 79 Gresham Street, LONDON, E.C.**

# YŌST

**THE TYPEWRITER FOR BEAUTIFUL WORK**

IS THE

**BEST MACHINE TO TEACH.**

It is now being offered on Very Special Terms to Schools and School Teachers.

*Particulars and Illustrated Booklet on Application.*

**THE YŌST TYPEWRITER CO., Ltd.**
50 HOLBORN VIADUCT, LONDON, E.C.

EVERY PRACTICAL TEACHER

. . Should Read . .

## SIGHT AND HEARING IN CHILDHOOD

By ROBERT BRUNDENELL CARTER, F.R.C.S.
AND
ARTHUR H. CHEATLE, F.R.C.S.

Price 2/- NET. - - - 2/3 Post Free.

Of all Booksellers or of
**THE SCIENTIFIC PRESS, Ltd.**
**28 & 29 Southampton Street, Strand, LONDON, W.C.**

## MANCHESTER Correspondence College.

PHYSIOGRAPHY.
MATHEMATICS.
CHEMISTRY.
SOUND, LIGHT, AND HEAT.
MAGNETISM AND ELECTRICITY.
MECHANICS.
PHYSIOLOGY.
HYGIENE.
NATURE STUDY.
BOTANY.
ZOOLOGY.
BIOLOGY.

Correspondence tuition is given in the subjects enumerated for the **BOARD OF EDUCATION (S.K.), MATRICULATION, INTERMEDIATE SCIENCE, SCHOLARSHIP, CERTIFICATE, A.C.P., L.L.A.,** and other examinations. Prospectus, with full particulars of Prizes ranging in value from 5s. to £5, will be sent on application. Intending students should join at once.

**TERMS—S.K.** (20 lessons) **Elementary, 10s.; Advanced, 15s.**

**Address—Secretary, Manchester Corr. College, 58 Grosvenor Street, Manchester.**

A New Work on the Teaching of Arithmetic

## METHOD IN ARITHMETIC

By GEORGE R. PURDIE, B.A.

With a Preface by the REV. A. C. HEADLAM, D.D., Principal of King's College, London.

Crown 8vo, 87 pp. Price, cloth, **1s. 6d.**

A book intended to help teachers in the difficulties of instructing young children in the earlier stages of Arithmetic.

SIR ISAAC PITMAN & SONS, LTD.
1 AMEN CORNER, LONDON, E.C.

**DELICIOUS COFFEE**

# RED WHITE & BLUE

**FOR BREAKFAST & AFTER DINNER.**

**In making, use less quantity, it being so much stronger than ordinary COFFEE.**

***England's Best Value***

# "BONGOLA" TEA

***Has no Equal***

Now if $v$ be the velocity at the instant when steam is shut off we have $ft = v = f_1 t_1$.

$$\therefore t_1 = \frac{f}{f_1} t.$$

$$\text{Hence } 2a = ft^2 + f_1\left(\frac{f}{f_1}t\right)^2 = f\left(\frac{f_1+f}{f_1}\right)t^2.$$

$$\therefore t = \sqrt{\left\{\frac{f_1}{f(f_1+f)} \cdot 2a\right\}}.$$

$$\therefore t + t_1 = \left(1 + \frac{f}{f_1}\right)t = \frac{f_1+f}{f_1}\sqrt{\left\{\frac{f_1}{(f_1+f)f} \cdot 2a\right\}}.$$

$$\therefore t + t_1 = \sqrt{\left\{\frac{f_1+f}{f_1 f} \cdot 2a\right\}}.$$

$$\therefore t + t_1 = \sqrt{\left\{\frac{\left(\frac{1}{n}+\frac{1}{p}\right)g + \left(\frac{1}{m}-\frac{1}{p}\right)g}{\left(\frac{1}{n}+\frac{1}{p}\right)g \cdot \left(\frac{1}{m}-\frac{1}{p}\right)g} \cdot 2a\right\}}.$$

$$= \sqrt{\left\{\frac{\frac{1}{n}+\frac{1}{m}}{\left(\frac{1}{m}-\frac{1}{p}\right)\left(\frac{1}{n}+\frac{1}{p}\right)} \cdot \frac{2a}{g}\right\}}.$$

*Bike.*—A right circular cylinder is bisected by a plane passing through the tangent at a point of the circular base; find the C.G. of one of the halves.

Let O be the centre of the circular base of the cylinder, and let three planes of reference be taken, viz. XOY the plane of the base, ZOX containing the axis of the cylinder OZ and passing through P, the given point on the circular base, and ZOY at right angles to each of the other two. Let $\bar{x}$, $\bar{y}$, $\bar{z}$ be the co-ordinates of the required C.G. Since the solid is obviously symmetrical with respect to the plane ZOX, we have $\bar{y} = o$.

Consider a thin slice of the solid parallel to the plane YOZ and distant $x$ from that plane. If $b$ denotes the width of the slice, then $b = 2\sqrt{r^2 - x^2}$, where $r$ is the radius of the base. Also if $h_1$ denotes the height of the slice we have $h_1 = \frac{h}{2r}(x + r)$, where $h$ is the height of the cylinder. Then representing the thickness by $dx$, the volume of the slice is given by $bh_1\,dx = \frac{h}{2r}(r + x)\,2\sqrt{r^2 - x^2}\,.\,dx$.

Now the volume of half the cylinder is $\pi r^2 \frac{h}{2}$. We have then

$$\pi r^2 \frac{h}{2} \cdot \bar{x} = \frac{h}{r}\int_{-r}^{r} (r + x)\sqrt{r^2 - x^2} \cdot x\,dx.$$

$$\therefore \bar{x} = \frac{2}{\pi r^3}\int_{-r}^{r} (rx + x^2)\sqrt{r^2 - x^2}\,dx.$$

Let $x = r \sin\theta$, then $dx = r\cos\theta\,d\theta$.

$$\therefore \bar{x} = \frac{2}{\pi r^3}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} r^2(\sin\theta + \sin^2\theta) \cdot r\cos\theta \cdot r\cos\theta\,d\theta.$$

$$\therefore \bar{x} = \frac{2r}{\pi}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (\sin\theta\cos^2\theta + \sin^2\theta\cos^2\theta)\,d\theta.$$

$$\text{Now } \int\cos^2\theta\sin\theta\,d\theta = -\int\cos^2\theta\,d(\cos\theta) = -\frac{\cos^3\theta}{3}.$$

$$\text{And } \int\sin^2\theta\cos^2\theta\,d\theta = \int\frac{\sin^2 2\theta}{4}\cdot\frac{d(2\theta)}{2} = \frac{1}{8}\left(\frac{2\theta}{2} - \frac{\sin 4\theta}{4}\right).$$

$$\text{Hence } \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (\sin\theta\cos^2\theta + \sin^2\theta\cos^2\theta)\,d\theta$$

$$= \left| -\frac{\cos^3\theta}{3} + \frac{\theta}{8} - \frac{\sin 4\theta}{32}\right|_{-\frac{\pi}{2}}^{\frac{\pi}{2}} = \frac{\pi}{8}.$$

$$\therefore \bar{x} = \frac{2r}{\pi}\cdot\frac{\pi}{8} = \frac{r}{4}.$$

Again, since $\frac{h_1}{2}$ is the distance of the centre of mass of the slice from the plane XOY, we have

$$\pi r^2\frac{h}{2}\bar{z} = \frac{h}{r}\int_{-r}^{r}(r + x)\sqrt{r^2 - x^2}\,\frac{h_1}{2}\,dx.$$

But we have seen that $\frac{h_1}{2} = \frac{h}{4r}(r + x)$.

$$\therefore \bar{z} = \frac{h}{2\pi r^4}\int_{-r}^{r}(r + x)^2\sqrt{r^2 - x^2}\,dx.$$

Hence, taking $x = r\sin\theta$ as before, we have

$$\bar{z} = \frac{h}{2\pi r^4}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} r^3(1 + \sin^2\theta) \cdot r\cos\theta \cdot r\cos\theta\,d\theta.$$

$$\therefore \bar{z} = \frac{h}{2\pi}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}(1 + \sin^2\theta)\cos^2\theta\,d\theta.$$

$$\text{Now } \int\cos^2\theta\,d\theta = \frac{\theta}{2} + \frac{\sin 2\theta}{4}\text{; and we have seen that}$$

$$\int\sin^2\theta\cos^2\theta\,d\theta = \frac{\theta}{8} - \frac{\sin 4\theta}{32}.$$

$$\therefore \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}(1 + \sin^2\theta)\cos^2\theta\,d\theta = \left[\frac{\theta}{2} + \frac{\theta}{8} + \frac{\sin 2\theta}{4} - \frac{\sin 4\theta}{32}\right]_{-\frac{\pi}{2}}^{\frac{\pi}{2}}$$

$$= \frac{5\pi}{8}$$

$$\therefore \bar{z} = \frac{h}{2\pi}\cdot\frac{5\pi}{8} = \frac{5}{16}h.$$

$$\text{Hence } \bar{x} = \frac{r}{4},\ \bar{y} = o,\ \bar{z} = \frac{5}{16}h.$$

*Dunelmian.*—Kindly give source of question. See Rule.

*Inter. Sc.*—A light string of length $l$ has its ends fixed at two points A, B, at a horizontal distance $a$ apart, and a heavy ring of weight W can slide on the string. Prove that the ring can rest vertically beneath B if a force $Wa/l$ be applied to it parallel to AB.

Let C be the position of the ring when at rest vertically under B. Let $x$ denote the length BC; then $l - x$ is the length CA.

$$\text{Hence } \cos\text{ACB} = \frac{x}{l-x}\text{, and } \sin\text{ACB} = \frac{a}{l-x}.$$

Now if the ring is kept at rest by a force R parallel to AB, and T is the tension of the string, we have

$$\text{T} + \text{T}\cos\text{ACB} = \text{W}.$$
$$\text{And} \quad \text{T}\sin\text{ACB} = \text{R}.$$

$$\text{Hence R} = \frac{\sin\text{ACB}}{1 + \cos\text{ACB}}\cdot\text{W}.$$

$$\therefore \text{R} = \frac{\frac{a}{l-x}}{1 + \frac{x}{l-x}}\cdot\text{W}.$$

$$\therefore \text{R} = \text{W}a/l.$$

*Replies to "J. B. H." and "Excelsior" are unavoidably held over. Replies can be had on application to the Query Editor, Office of the Journal.*

BRITISH MUSEUM 29 MH 1906

## BOOKS FOR PUPIL TEACHERS AND KING'S SCHOLARSHIP CANDIDATES

*REVISED AND ENLARGED EDITION*

**THE GRAMMAR, HISTORY, AND DERIVATION OF THE ENGLISH LANGUAGE.** With Chapters on Parsing, Analysis of Sentences, and Prosody. By the Rev. Canon DANIEL, M.A., formerly Principal of the National Society's Training College, Battersea. Price **5s.**

**LOCKE'S THOUGHTS ON EDUCATION.** With Introduction and Notes by the Rev. Canon DANIEL, M.A. Price **4s.**

NOTE.—*The above is a complete edition of the work, and is illustrated by passages from eminent Educationists.*

**HOW TO PREPARE NOTES OF LESSONS.** A Manual of Instruction and Models for Pupil Teachers and Students in Training Colleges. By W. TAYLOR, Normal Master in the National Society's Training College, Battersea. Price **2s.**

**NOTES OF GRAMMAR LESSONS.** Being a complete Course of Graduated Teaching in the Parsing and Analysis of Sentences, with Models, Exercises, and Examination Papers. Price **2s. 6d.**

**NOTES OF ARITHMETIC LESSONS.** Being a course of Lessons in Elementary Arithmetic, together with a complete series of Questions in Mental Arithmetic, and nearly Fourteen Hundred other Original Examples. Price **2s. 6d.**

**MANUALS OF THE SCIENCE AND ART OF TEACHING—**

**The Teacher's Manual of the Science and Art of Teaching** includes the Cultivation of the Senses, the Cultivation of the Memory, the Use of Words, Discipline, Class Teaching, Teaching by Apparatus, and the Best Methods of Teaching Grammar, Arithmetic, Geography, History, Reading, and Writing. Price **5s. 6d.**

**The Advanced Manual of Teaching,** which relates to the Training of Pupil Teachers, and to the Art of Teaching English Literature, Languages, Mechanics, Animal Physiology, Physical Geography, Botany, and Domestic Economy. Price **5s. 6d.**

NOTE.—*Any of the above Manuals may also be had separately, price* 6*d.*, 8*d.*, *and* 10*d. each.*

**THE PUPIL TEACHER'S COURSE OF MATHEMATICS.** By a late Fellow and Senior Mathematical Lecturer, Examiner for the Oxford and Cambridge Board, &c.

Part I.—Euclid, Books I. and II. Price **1s. 6d.**
Part II.—Algebra. Price **1s. 6d.**

**NATIONAL SOCIETY'S DEPOSITORY,**
**Broad Sanctuary, Westminster S.W.**

## New Geometry

### *The "Spencer" New Geometry Cards*

Being **Two Sets of Cards Illustrating the Geometry of Pattern Making.** Each Set contains **24 Plates.** The Problems are mainly of three kinds:—(1) **Bands or Borders.** (2) **"All Over" Patterns.** (3) **Units based on Definite Construction.** By H. W. DONALD, Designer of the "Alma" Floral Brush-Work Designs. Set **A,** Elementary. Price, net, **1s. 6d.** Set **B,** Advanced. Price, net, **1s. 6d.**

## Brush Work

### *The "Modern" Pencil and Brush-Drawing Designs*

By H. W. DONALD, Designer of the "Alma" Floral Brush-Work Designs. Being **Two Sets of Floral Designs,** each containing **24 Cards** printed in colours for **Freehand** and **Colouring,** separately or combined. The Cards provide excellent Material for teaching the **Elements of Design** and **Colour Harmony.** Set **A,** Elementary. Price, net, **2s.** Set **B,** advanced. Price, net, **2s.**

## Free-Arm Drawing

### *Nature Forms: A Book of Free Drawing*

By HENRY T. WYSE, Art Master. Containing **20 Plates** of suitable and suggestive Designs, for use in either the **Nature Knowledge** or the **Drawing Lesson.** Price, net, **3s.** (*Adopted by the London County Council.*)

**CHARLES & DIBLE,**
**LONDON: 10 PATERNOSTER SQUARE**
**Also at GLASGOW and DUBLIN**

*NOW READY.* *Price 3d.; post free, 4d.*

## The Practical Teacher's Art Monthly

**For APRIL**

*SELECTION FROM CONTENTS*

SOME NOTABLE FRENCH ETCHINGS.
A COURSE OF DRAWING FOR PRIMARY SCHOOLS.
SYLLABUS FOR THE TEACHING OF DRAWING AT THE ELEMENTARY SCHOOLS OF LEIPZIG.
SHADED MODELS.
THE NEW EXAMINATION IN DRAWING OF COMMON OBJECTS FROM MEMORY.
TOOLS, AND HOW TO USE THEM.
ART TEACHING IN JAPAN.
A FURTHER COURSE OF CLAY-MODELLING.
A PAGE FOR SENIORS.

***Order from your Bookseller now, or send to***

**THE PRACTICAL TEACHER OFFICE—**
**MESSRS. T. NELSON AND SONS,**
**35 & 36 PATERNOSTER ROW, LONDON, E.C.**

## LANTERN SLIDES, BEST .... WET-PLATE

**Geography, Science, Art, History, &c.**
**List Free from WILSON, LOCHHEAD, ABERDEEN.**

## EXAM. BOOK-KEEPING, &c.

***Sarll's Text-Book Sales over 200,000 Copies.***

**SARLL'S BOOK-KEEPING FOR NEW CODE.** Stage I. Introductory; II. Practical; III. Theory or Journalising. Each 48 pp. Price **4d.** Outline Keys. *Schoolmaster* says:—"They are the *best and cheapest* manuals of the kind in the market." MS. Books, **2d.** each.

**SARLL'S PRACTICAL BOOK-KEEPING.** Fourteenth and *greatly* improved Edition. *Teachers' Aid* says:—"There is no *cheaper* and *safer* guide." Consists of Grad. Exercises and Exam. Papers, with *full* or *outline* Keys. 128 pp. **1s.** MS. Books, superior, **1s.** Cheap, **4d.**

**SARLL'S DOUBLE-ENTRY BOOK-KEEPING.** Fifteenth Edition. **2s.** Complete with *full* or *outline* Keys. *Practical Teacher* says:—"We *heartily* recommend it as the *best* and *cheapest* manual we have seen." For Soc. of Arts Exams., Civil Service, &c. 256 pp. MS. Books, **1s.** Cheap, **4d.**

**SARLL'S TWENTIETH CENTURY EXAM. PAPERS IN BOOK-KEEPING.** Containing the *latest* papers by the *leading* EXAMINING BOARDS, with notes and brief answers, in *two* parts, SIXPENCE each. Part I., JUNIOR PAPERS, College of Preceptors, University Local, &c. Part II., SENIOR PAPERS, Society of Arts, London Chamber of Commerce, &c.

**SARRL'S STUDENTS' BOOK-KEEPING.** Chapters—Introductory, Theory, Practice, Exam. Papers, Trial Balances, Company Book-keeping, Mis. Difficulties, Sup. Papers, &c., &c. All Exercises with *full* or *outline* Keys. Over 400 pages. Price **3s. 6d.** *In the Press, and ready in January.*

*SUPPLEMENTARY KEYS*

I. **TO SARLL'S PRACTICAL.** Exercises Fully Worked. **2s.**
II. **TO SARLL'S DOUBLE-ENTRY.** Exercises Fully Worked. **3s.**

*** **Specimen Copies—except Keys—at one-third off, or Teachers can have Parcels, for inspection, Post Free, from A. SARLL, A.K.C. (Lecturer, People's Palace, E., Polytechnic, W., Goldsmiths' Institute, S.E., &c.), 62 Oakley Road, London, N.**

*Lessons by Correspondence and Exams. conducted.*

*London: GEORGE GILL & SONS, 13 Warwick Lane, E.C.*

**Be sure and order at once Part I. of**

## THE HARMSWORTH ENCYCLOPÆDIA

# An Announcement of Importance! = =

Readers of the PRACTICAL TEACHER will be interested in the announcement that they are now able to procure a thoroughly new and absolutely reliable

## Encyclopædia = for ½d. per day

Good Encyclopædias have been published in the past, but their price and size have made them suitable for a very limited class. As a rule, the securing of these comprehensive reference works has meant "running into debt."

**NO DEBT INCURRED**

The man or woman who incurs a debt for the purchase of books of any kind rarely derives much benefit from them. There is always the worry of not being able to meet the next payment. The cost of all Encyclopædias up to the present time has been so prohibitive that the number of subscribers has always been of necessity limited.

**EVERYBODY CAN AFFORD**

a halfpenny a day, though, for this latest and most up-to-date reference work—the

# Harmsworth Encyclopædia

**Specially prepared and printed for the people at a popular price by Thomas Nelson and Sons**

*At all Newsvendors' and Bookstalls*

**Part I. Now Ready**

# A Few Facts about this = =
# Epoch-making Encyclopædia

Hundreds of Specialists have been engaged in its preparation.
With it in your home or office you need never be at a loss for any fact, date, or statistics.
You can range from yesterday to Prehistoric Times.
It is new from cover to cover, and contains **50,000** entries.
Every article in each part is revised up to the hour of printing.
The

# Harmsworth Encyclopædia

keeps in view practical everyday questions.
It gives the pith and essence of the world's accumulated knowledge.
Published in fortnightly parts at **7d.**—a halfpenny a day. The entire cost is a little over **£1.**
Each part will consist of no fewer than **160** pages.
The whole will consist of Eight Handsome Volumes of convenient size, with as many as **6400** pages and **50,000** entries.

## YOUR BOOK OF REFERENCE

| | |
|---|---|
| YOUR HISTORY | YOUR DOCTOR |
| YOUR GEOGRAPHY | YOUR LAWYER |

## The Most Up-to-date Book in the World

*At all Newsvendors' and Bookstalls*

**PLACE YOUR ORDER TO-DAY**

## Part I. Now Ready

# THE NORMAL

**PRINCIPALS: Mr. LYDDON-ROBERTS and Professor DENNEY**

## 1905 RESULT

**FIVE** NORMAL STUDENTS
HEAD THE LIST

## 1904 RESULT

**Of the 7 top King's Scholarship Candidates who had the benefit of correspondence tuition no less than 4 were pupils of the Normal. Previous to this year the Normal has twice taken**

**THE HIGHEST PLACE**

**of any correspondence class or college.**

*Our* **£100** MONEY PRIZE AND **GOLD** MEDALS

*Our* **£50** MONEY PRIZES AND **SILVER** MEDALS

*Our* **£25** MONEY PRIZES AND **SILVER** MEDALS

*Our* **£10** MONEY PRIZES AND **SILVER** MEDALS

**ALL** THESE PRIZES HAVE BEEN AWARDED

# TESTIMONIALS FROM SOME PRIZE-WINNERS

***(Testimonials from other Prize and Medal Winners will be announced later)***

## £100 & GOLD MEDALS

**Mr. Geo. Mincher, 9 Victoria Park, Fishponds, Bristol. February 25th, 1905.**

"I must thank you sincerely for your congratulations on Scholarship Exam. Your College was a great help to me in preparing for this examination. Your system is excellent in all respects; the notes are very helpful, being clear and containing nothing that is not required for the examination, the maximum of work thus being done in the minimum of time. This is also contributed to by the very careful marking and prompt despatch of papers. The questions you set were also a good indication of what was to be expected in the examination. Your notes also contributed to my success (1st Class) at London Matriculation." (*First Class, Division* 1.)

**Mr. C. A. Baggley, 13 Sydney Street, Burton-on-Trent. February 28th, 1905.**

"Since I was student of your Correspondence Class, and as I have been placed in the 1st Division of the 1st Class, I wish to thank you for the way my papers were marked, and the prompt manner in which they were returned, accompanying solutions and fresh work." (*First Class, Division* 1.)

**Mr. Alec. Thomson, 57 Heigham Street, Norwich. March 1st, 1905.**

"Please accept my sincere thanks for your cheque. I have found your 'Self-Preparation Course,' through which I worked, in every way efficient, and in itself a guarantee of success to any student working through it conscientiously." (*First Class, Division* 1.)

**Mr. P. Channing, 21 Bryniand Avenue, Bishopston, Bristol. February 27th, 1905.**

"I must thank you for the excellent tuition I received through your Classes. I found that the weekly questions I answered for you were of great assistance." (*First Class, Division* 1.)

**Mr. W. H. Bucknell, 61 Coronation Road, Southville, Bristol. March 2nd, 1905.**

"With best thanks I beg to acknowledge receipt of cheque." (*First Class, Division* 1.)

## £50 & SILVER MEDALS

**Miss May Southerst, 19 School Lane, Brinscall. February 28th, 1905.**

"I desire to thank the members of your staff for the help and guidance I have received during the Course for Scholarship. The notes and criticisms I found to be most useful, and contributed in a marked degree to the success I have been enabled to attain in the exam." (*First Class, Division* 2.)

**Mr. W. H. Robey, 70 Adams Road, Kingston, Portsmouth. March 1st, 1905.**

"The continued success of your students year after year forms in itself a proof of the genuineness of your system of tuition. Regarding myself, I can say that the tuition you have given me has been eminently satisfactory in every way." (*First Class, Division* 2.)

**Mr. E. Cull, 135 St. Mary's Road, Kingston, Portsmouth. February 26th, 1905.**

"I am delighted with the result, and am exceedingly pleased to hear that the 'Normal' has again done so well. In every way I found your tuition entirely satisfactory, and I am sure that I owe my success in no small measure to your tuition." (*First Class, Division* 2.)

**Mr. A. Tracey, 20 Wimpole Road, Colchester. February 24th, 1905.**

"I am pleased to be able to inform you that I have obtained a place in Class 1, Division 2, thus qualifying for your 2nd Prize. I cannot allow this opportunity to pass without again thanking you for your tuition. All the notes you sent were second to none." (*First Class, Division* 2.)

**Mr. Thomas Herdsman, West View, Dipton, R.S.O. February 25th, 1905.**

"I also again take the opportunity of thanking you for past favours, and for your kind interest in my behalf during the time I was under your tuition." (*First Class, Division* 2.)

**Mr. John Jones, Tynlon P.O., Bodwrog, Llangefni, Anglesey. March 4th, 1905.**

"Accept my sincerest and warmest thanks for the cheque to hand this morning. I shall send a testimonial next week." (*First Class, Division* 2.)

*Testimonials from other Normal Students in First Class, Division 2, have had to be omitted from want of space.*

## £25 & SILVER MEDALS

*Awarded in accordance with our Prize Scheme to First Class, Division 3. Large numbers of Testimonials from Boys and Girls in this division will be published later.*

## £10 & SILVER MEDALS

*Awarded to First Class, Division 4. Testimonials from these Boys and Girls (a large number) will be published later.*

**NORMAL CORRESPONDENCE COLLEGE:** 47 MELFORD ROAD, EAST DULWICH, S.E., and 110 AVONDALE SQUARE, S.E.

COUPON
PRACTICAL TEACHER
April 1905

PRINTED AND PUBLISHED BY THOMAS NELSON & SONS, PROPRIETORS, AT THE OFFICE OF "THE PRACTICAL TEACHER," 35 & 36 PATERNOSTER ROW, LONDON, E.C.